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A. D. MELVIN, CHIEF OF BUREAU.

INVESTIGATIONS IN THE MANUFACTURE
AND CURING OF CHEESE.

VI.—THE COLD CURING OF AMERICAN CHEESE,
WITH A DIGEST OF PREVIOUS WORK ON THE SUBJECT.

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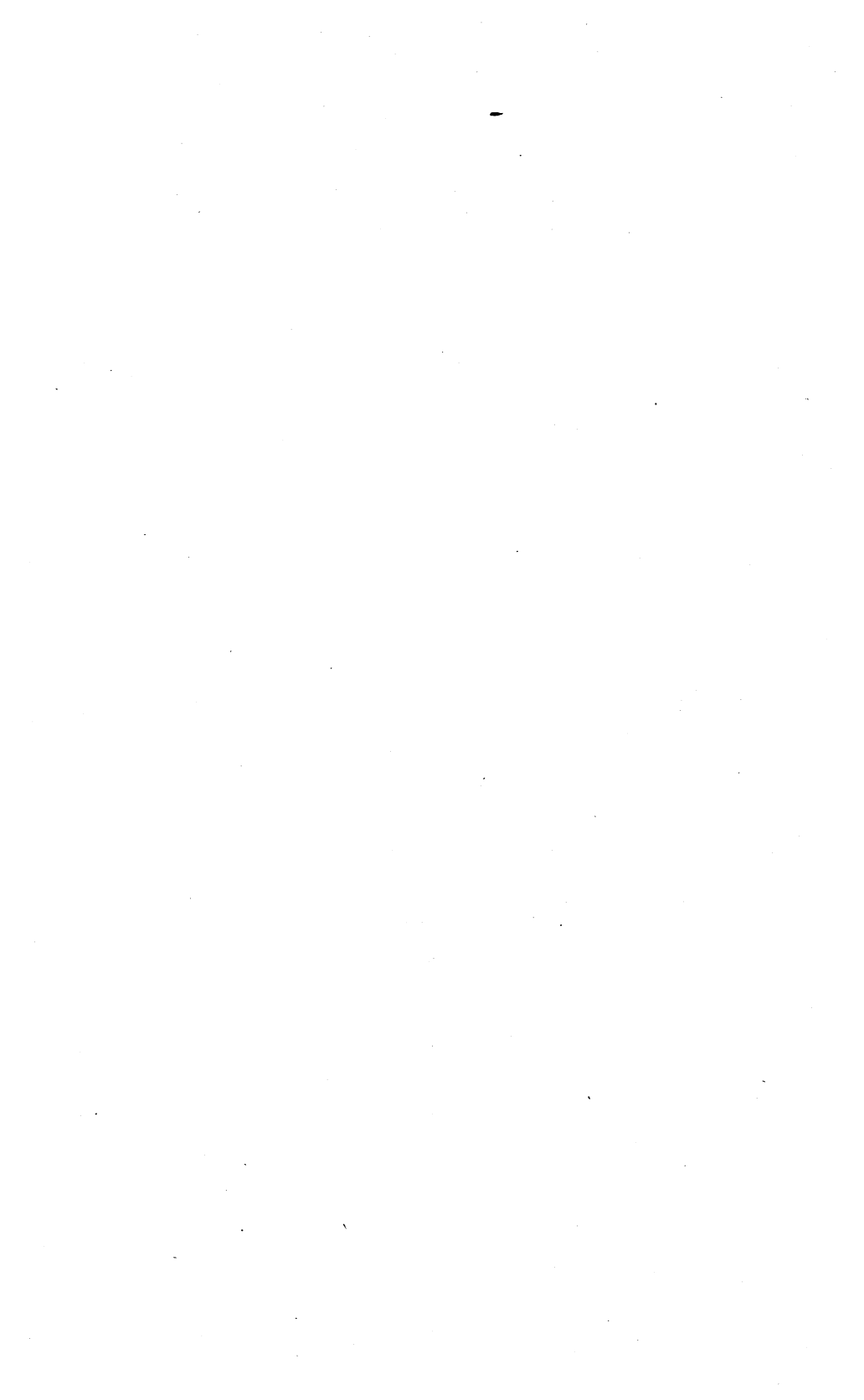
U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY,
Washington, D. C., May 10, 1906.

SIR: I have the honor to transmit herewith a manuscript entitled "The Cold Curing of American Cheese," by C. F. Doane, expert in charge of cheese investigations of the Dairy Division of this Bureau. This paper, which is one in a series on Investigations in the Manufacture and Curing of Cheese, contains a report of recent experiments by the Dairy Division, prefaced by a review of previous work in cold curing. In view of the undoubted value of this information for the cheese industry of the country I recommend its publication as a bulletin of this Bureau.

Respectfully,

A. D. MELVIN,
Chief of Bureau.

HON. JAMES WILSON,
Secretary of Agriculture.



INTRODUCTION.

This bulletin is the sixth in a series on Investigations in the Manufacture and Curing of Cheese. The previous numbers, which were issued under separate titles and not given the general title or special numerical designations now adopted for the series, are as follows:

I. The Cold Curing of Cheese. Bulletin No. 49.

II. The Relation of Bacteria to the Flavors of Cheddar Cheese. Bulletin No. 62.

III. The Camembert Type of Soft Cheese in the United States. Bulletin No. 71.

IV. Fungi in Cheese Ripening: Camembert and Roquefort. Bulletin No. 82.

V. The Cold Storage of Cheese. Bulletin No. 83.

The work to be reported in this series will consist of investigations in the manufacture and curing of American, or Cheddar, cheese and in the manufacture and adaptation to American conditions of the more important European varieties of cheese.

The present bulletin treats of the effect of different low temperatures of storage, and the time of putting into storage, on the curing of American or Cheddar cheese and includes a digest of all previous work on this subject. The experiment herein reported was inaugurated to study, under factory conditions and on a commercial basis, the problems of temperature in curing and storage. This plan made it possible to use larger quantities of cheese than had ever before been used in work of this kind.

The author of the bulletin, Mr. C. F. Doane, dairy expert in charge of the cheese section of the Dairy Division, planned and executed the work in all its details. The cheese was made in a large commercial factory near Plymouth, Wis., and the storage or curing experiment was carried on at a cheese-storage warehouse at Plymouth, in rooms specially built and equipped for the work.

ED. H. WEBSTER,
Chief of Dairy Division.



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INVESTIGATIONS IN THE MANUFACTURE AND CURING OF CHEESE.

THE COLD CURING OF AMERICAN CHEESE.

PRELIMINARY REMARKS.

There is a general opinion of long standing that it is necessary for cheese to go through a ripening or breaking-down process before it is fit for human food. The green cheese as it comes from the press has a consistency much like that of india rubber and feels somewhat like that substance to the touch. In addition there are certain physiological effects popularly supposed to follow the eating of green curd as it comes from the vat, and this supposition has grown into a belief on the part of both scientist and layman that the green cheese is partially if not almost wholly indigestible. These opinions, which will very likely be shown to have little foundation in fact, made it seem desirable that the cheese should go through a ripening or breaking-down process before it reached the hands of the retail dealer and consumer. But it is not the purpose in this bulletin to go into any discussion of the changes that occur during this ripening period; they are very complicated, are probably due to a number of disputed causes, and are evidently not thoroughly understood by scientists in general.

The outward evidence that this ripening has progressed to a supposedly sufficient extent is a change in the physical condition of the cheese, in which the curd loses its elastic consistency and becomes friable and waxy to the touch and somewhat soluble in water. During this process, when carried through under old factory conditions, there is also a decided change in the flavor. The flat and insipid taste of the green curd disappears, and the product acquires a characteristic cheesy flavor, which becomes strong and sharp as the ripening progresses.

As will be discussed in greater detail later, a decided change has evidently taken place in the tastes and desires of the consumer along this line. The market is progressing toward a milder cheese, and this change has evidently come with the new ideas in regard to curing. Under the old system of warm curing rooms the consumer had very little chance to become acquainted with anything but a product well broken down in texture and highly developed in flavor. While it is

hard to predict the future course of the consumer's taste in this connection, it is very doubtful if we shall ever arrive at the time or condition when as a general thing some flavor is not desired in the cheese. This comparative demand for mild or for strong cheese is very naturally of considerable interest in connection with any question concerning methods and conditions of curing. Especially is this true in the discussion of methods which are likely to cause a great variation in the flavor of the product. The old system of warm rooms developed a high flavor; the new system of cold rooms has a tendency to suppress flavor entirely. To ascertain the public taste and meet it by modifications will probably prove to be almost a necessity in the cheese-curing industry.

In the American or Cheddar cheese industry of the present time there are two very important practical questions, one of recent origin and the other recognized for several years. These are so closely related that it is almost impossible to consider them separately, as they depend to a great extent upon each other. The recent question has already been mentioned, and relates to the growth of the popular demand for mild cheese; the other is the problem of the influence of temperature on the curing of cheese, which has been studied for about ten years and which has a number of points that have not yet been settled to the satisfaction of cheese dealers in general.

In the early days of the industry in this country not much attention was paid to the question of the effect of temperature on curing. The curing rooms or "dry houses," as they were called, had very little or no provision against changes in temperature, and it is probable that the temperature followed closely that of the outside atmosphere. The practice of winter cheese making is of comparatively recent origin, so that there was, as a rule, no necessity for any provision against the freezing of the product. Heat was not supposed to have any effect in the curing—it would at least so appear from a description of the old curing rooms—and consequently no attempt at insulation was made. It was not until 1895 that this question of curing-room temperature was considered of sufficient importance to warrant any attempt being made to determine if any benefit could be derived from the employment of an artificial temperature lower than the temperature prevailing during a large part of the summer. It is somewhat astonishing that this should have been the case, as at the present time it is so well recognized that the effects of high temperature on cheese are plainly unfavorable that we do not understand why the cheese maker of twenty or thirty years ago should not have perceived this and tried to remedy it. We know that where a cheese has any tendency whatever to a gassy nature the heat immediately causes it to swell or huff up to an extent causing considerable damage to its commercial value. We also know that the heat causes the grease to come out of the

cheese, and that it has a tendency to develop any latent undesirable flavors; in fact, there are but few respects in which heat does not have an unfavorable influence. And yet it would appear that the cheese maker of those days entirely overlooked these things. It is likely that he considered these evils as more the result of the season than the effect of any conditions that were within his control.

The first scientific theories worthy of consideration in connection with the curing process did not tend to help matters to any extent. As soon as the science of bacteriology had grown to any importance the ripening of cheese was studied from this point of view, and it was very generally concluded that the process was almost entirely due to bacteriological changes. It was believed that these changes could not take place in a temperature below that at which the germs developed to the best advantage. This would require from 60° to 80° F., and it was naturally supposed that anything within these limits was proper and necessary.

REVIEW OF PREVIOUS EXPERIMENTS IN COLD AND COOL CURING.

The first work to determine the influence of lower temperatures on the ripening of cheese was undertaken by the Wisconsin Experiment Station in 1895.^a In this experiment cheese was cured at three temperatures, 50°, 60° to 65°, and 85° F. It was found that the cheese cured at 50° F., though requiring a much longer time than the cheese cured at the higher temperatures, broke down fully as well. It was considered by the judges to have about the same quality and value as the cheese cured at the temperature of from 60° to 65° F. It was found in this experiment that the cheese cured at 85° F. was very strong and almost unfit for use.

This proof that cheese could be cured satisfactorily below 60° F. had in it the germ of a revolution in ideas and practices concerning the process. Two important facts were brought out; the first, that cheese could be cured at a temperature much below that at which bacteria, supposed to have so much influence on the curing, could very well develop; the other, in connection with the bacteriological study which was conducted at the same time with the cheese under experiment, that the bacteria persisted in large numbers much longer in the cheese kept at a low temperature than in that kept at a higher temperature.

These experiments were soon followed by similar work in Iowa,^b in Canada,^c and by the New York State Experiment Station at Geneva.^d These experiments, which were along parallel lines and gave similar results, will be mentioned again.

^a Annual Report, Wisconsin Experiment Station, 1897.

^b Bulletin No. 57, Iowa Experiment Station.

^c Annual Report, Ontario Agricultural College and Experimental Farm, 1900.

^d Bulletin No. 184, New York Experiment Station.

THE SUBEARTH DUCT.

The conclusion, drawn from the work of these experiment stations, that low temperatures for curing could be profitably employed led to attempts to secure a lower range of temperature in the rooms already in use. An effort was made to provide better insulated curing rooms in which the temperature would not be greatly affected by hot weather outside. In a few instances in Wisconsin and in many instances in Canada some attempt was made to secure lower temperatures by artificial means. The best known of these devices is what is called the subearth duct, which is worthy of notice in any discussion of the subject of temperatures in connection with cheese ripening. The principle of the subearth duct, as is well understood by cheese men acquainted with the subject, was based upon the fact that the temperature of the earth several feet below the surface remains practically stationary and is much below the average temperature of the atmosphere during the summer months. Several lines of tiles, such as are used for drainage purposes, were laid at varying depths beneath the earth's surface and provided with a funnel which turned toward the wind at the opening where the pipe came to the surface. There was also a funnel which acted as a draft above the curing room and served to draw the air through these tiles and into the curing room. The room itself, of course, was well insulated, and it was found that by this means a fairly even temperature could be maintained at about 60° F. There were certain modifications of this duct, in some instances the curing-room air being drawn from near the bottom of a well in much the same manner. This was also a success in regulating the temperature.

In this country this method of maintaining a suitable and even temperature was for various reasons never very extensively applied, there being a difference of opinion regarding its efficiency. A number of cheese makers who had cool-curing rooms believed that they could make a softer cheese than had been customary in hot weather, but when this cheese passed from the hands of the maker to the dealer and was brought in contact with higher temperatures it caused unfavorable comment. This was wrongly and unreasonably charged to the subearth-duct curing room, when in fact it was the fault of the maker. There was also said to be considerably more trouble with mold than had been the case with the old-style curing rooms.

Had there been any necessity for the continuation of this method for securing low temperatures there is little doubt that the subearth duct or some other artificial means of obtaining the same results would have come into general use in the better cheese districts, for at the present time the bad effects of any high degree of temperature in the curing of cheese are thoroughly understood. But other methods and systems of handling cheese were developed, founded on new discover-

ies, and the development of the cold-storage system did away with any necessity for a cool factory curing room.

Following the introduction of cold-storage curing, cheese was held in the factory for a much shorter period than formerly. The subearth duct was expensive, and well-insulated curing rooms were found to be satisfactory for the shorter period before going to the storage room.

THE WISCONSIN WORK IN COLD CURING.

The work in Wisconsin, already mentioned, led Doctors Babcock and Russell to believe that the processes through which cheese passed in curing were due partially at least to other agencies than bacteria. Investigations were conducted which led to the discovery of galactase,^a an enzyme natural to milk and which has the power of breaking down the casein. It is not the purpose of this bulletin to enter into any details of that discovery or of the controversy that has resulted between scientists on this general subject of cheese curing. This discovery indicated that it might be entirely possible to cure cheese at a much lower temperature than had previously been used, and naturally led to experiments along this line. There is no doubt that this discovery has been responsible for many changes in the cheese industry, for it has affected the curing processes, has indirectly modified the taste of the consumer, and a long series of changes has followed, some of which are still in progress.

The Wisconsin Station was the first to inaugurate experiments in the cold curing of cheese.^b This very naturally followed the discovery of galactase and the previous experiments in cool curing, which might be considered as preliminary to the greater work that followed. Wisconsin's first work along these lines was followed in a short time by similar experiments at Guelph, Ontario, Canada, under the direction of Professor Dean, head of the dairy department of the Agricultural College. About an equal amount of work has been done by these two institutions, but of course that done by Wisconsin will always be of the greater interest, because to this station belongs the credit of having made the discovery which naturally led up to this work, and because of its general activity along these lines.

THE FIRST COLD-CURING EXPERIMENTS.

The first actual cold-curing experiments were undertaken at the Wisconsin Station following the discovery of galactase.^c In these tests five temperatures were employed, 15°, 33°, 40°, 50°, and 60° F.

^a Annual Report, Wisconsin Experiment Station, 1897.

^b "Cold curing" is the term ordinarily applied to curing at temperatures below 50° F., to differentiate it from the method employed in Canada, where artificial temperatures above 50° F. are used and the process is termed "cool curing." These terms are well understood by cheese men and are entirely distinct.

^c Annual Report, Wisconsin Experiment Station, 1901.

Three different lots of cheese were stored at these temperatures, the lots being made up, respectively, with 3, 6, and 9 ounces of rennet to 1,000 pounds of milk. Chemical analyses made periodically after the cheese was put into storage showed by the soluble proteids that the cheese broke down more slowly in the lower temperatures. There was, however, a steady, though slow, change even at the lowest temperature of 15° F. The increased amount of rennet, according to the analyses, showed marked influence in hastening the breaking down of the curd.

In storing these cheeses at the different temperatures it was found that 40° and 50° F. gave the best results when considered by the market standards of that time. The temperature of 60° F. gave a cheese with impaired flavor and injured texture. In these tests the high-rennet cheese had the best texture, the flavor being as good as with the lower rennet. A peculiarity often noticed in cheese held at a low temperature was first seen in these experiments—that is, the development of white specks throughout the body of the cheese, which might be considered as injuring its commercial value to a very slight extent. The cheeses in these experiments were cut and photographs were made which showed the close texture of the cold-cured cheese. At the temperature of 15° F. a soggy, crumbly texture was found.^a In this report the first suggestions were made as to the advisability of building centralized curing rooms, and the report also mentioned further experiments which were then in progress along the same line. Only partial results were given, the full statement of the completed experiment being left for a future publication.

In the publication covering the completed experiment^b data are given as to the effect of a long period of time on the cheese carried at 33° and 40° F. This cheese was found to be of fine quality at the end of two years, while that held at 50° F. was on the decline at the end of sixteen months.

LATER WORK.

The details of three additional series of experiments are given in the same report. In the first of these the cheese was made at the university, the normal amount of rennet being added and the cheese being stored at 15°, 40°, and 60° F. The cheese held at 60° F. commenced to deteriorate in quality at about six months, and was putrid at about fourteen months. The cheese placed in the 15-degree temperature was removed to a 40-degree room at the end of seven months. In this series the cheese held at 60° F. received the highest total score, which was given when it was five months of age. The cheese kept at 40° F. received a maximum score of 1 point less than the 60-degree cheese,

^a Further experiments modified this conclusion.

^b Annual Report, Wisconsin Experiment Station, 1902.

reaching this at fourteen months. The cheese held at 15° F. scored very low until placed in the 40-degree room, when it commenced to improve and developed into a very fine product.

The second experiment of the series was made in a regular cheese factory, and the report states that the results are entitled to more weight than those of previous trials, as all the cheese came from the same vat. The cheese was made with 3 ounces of rennet, and was stored at 15°, 40°, 50°, and 60° F. Before being stored the cheese was divided into three lots. The first lot went into storage direct from the press, the second lot was held at 40° F. for fifteen days and then stored the same as the first lot, and the third lot was kept at 40° F. for thirty days and then stored as the others. The temperatures of 50° F. and below seemed to give the best results, the cheese cured at 50° F. being the best of all. Part of the cheese held for fifteen and thirty days at 40° F. and then for five months at 15° F. was then removed to the 40-degree room. At the end of one year some of this cheese had an almost perfect score.

The cheese for the third and last series was made in a commercial factory and was stored at 32°, 35°, 40°, and 60° F. The results were the same as in the previous trials. A number of duplicates which were put into storage were afterwards sold in the Chicago market and brought prices considerably above that obtained for ordinary cheese.

These three experiments strongly emphasized the fact that in body and texture all the cheese kept at the lower temperatures was superior, but according to the market standards of that time it would appear that the cheese cured at 60° F. was superior to the others in flavor at some periods of its ripening and would probably have brought better prices. As this prime condition for the 60-degree cheese was at about five months of age, it is exceedingly doubtful if the improved quality at the lower temperatures was of any practical benefit.

RESULTS OF WISCONSIN EXPERIMENTS.

The work done by the Wisconsin Station was summed up in another report,^a a number of points being emphasized which had been brought out in the work of the station and which had not been given much prominence in previous reports. Attention was called to the fact that the cheese cured in cold storage was much more uniform in quality than that cured under the old conditions. It was stated that most factories suffered considerable loss from the rejection of cheese because of its inferior quality. It was pointed out that such losses were in part due to the use of tainted milk and to variation in manufacturing details, but in large measure they might be

^a Bulletin No. 94, Wisconsin Experiment Station.

ascribed to variation in curing conditions due to inefficient methods of control. Of these curing conditions, temperature was by far the most important. With cheese cured at lower temperatures the effect of these factors was much modified, with reference not only to the conditions which occurred in the curing, but also to the variations in conditions of manufacture. The result showed that with a lower temperature the quality of the cheese is more uniform, and the product would naturally bring a somewhat higher price and be more sought after by the buyer.

An interesting feature of the work carried on by the Wisconsin Station was the placing of cheese at a temperature below freezing, 15° or 17° F. It has always been believed by people familiar with the handling of cheese under storage conditions, and it seems to be an opinion firmly held at the present time, that a temperature low enough to freeze is detrimental, if not ruinous, to the cheese. The first report of the Wisconsin Station seemed to support this idea. Cheese came from the low temperature in a very unsatisfactory condition; but further experiments along this line gave a slightly different result, the cheese being handled differently after coming from the colder temperature. In the first experiment it was scored immediately after coming from the 15-degree room. In subsequent experiments the cheese was placed in a warmer room for a time, and, as has been previously noted, there was an immediate and constant improvement until it reached an almost perfect condition, showing that the bad effect of the freezing of the cheese was only temporary. While this fact is interesting from a scientific point of view, it is doubtful if under the present market conditions it can ever be put into practical application. It is true that the cheese kept much longer at this lower temperature, and it is also probably true that the cheese could be held indefinitely at 15° F., but it is difficult to see how this could be applied to any commercial condition where it would be of any value. In short, it is doubtful if it is ever advisable to keep cheese longer than nine or ten months. Conditions may some time arise under which this would be desirable, but it is now difficult to imagine any future conditions to warrant this temperature being applied to any cheese as it comes into storage.

CANADIAN EXPERIMENTS IN COLD AND COOL CURING.

As has been already mentioned, the Ontario Agricultural College followed very closely the lead of the Wisconsin Experiment Station in curing experiments involving the effect of different temperatures.^a In the first experiments cheese was cured at 60°, 66°, and 69° F., and it was found that that cured at 60° F. was of higher quality, both in texture and flavor, than that cured at either of the other

^a Annual Report, Ontario Agricultural College and Experimental Farm, 1898.

temperatures. The cheese cured at the highest temperature went off in flavor very rapidly. The tests ran through a period of two months and included a large number of lots of cheese. In a series of cooperative experiments with cheese factories the same temperatures were employed and the same results were obtained.

During the following year the previous tests were repeated.^a Results were the same as before, the cheese cured at the lowest temperature being the best in quality. It was found in these tests that cheeses of varying sizes were affected in practically the same way by the different temperatures. Some of the cheese was carried at a high temperature obtained artificially, and was then placed in the cool rooms, but this was found to be of no advantage, though no comment was made indicating that it was of any particular disadvantage.

All of the foregoing work was again repeated the following year.^b Practically the same conditions were met as in the previous experiments, cheese being cured at 60°, 65°, and 70° F. The same results were obtained, and, as before, cheese held at a warmer temperature for one week before going into colder rooms showed no benefit derived from this process. In all of these experiments the score for flavor had been about the same for the different temperatures, but the texture was very markedly improved at the lowest temperature.

The year following a partial report was made on the employment of a 40-degree temperature for curing.^c While the experiment had not been completed at the time of making the report, there was evidence that the cheese carried at 40° F. would be better than the control cheese carried at 65° F.

In a bulletin published in 1902 the final results of the work last mentioned were given.^d It was stated that the temperature of the cold room averaged 38° F. and that the average temperature of the warm, or control, room was 64° F. One cheese from each lot made was placed directly in the cold room, and three others were kept in the warm room for one, two, and three weeks, respectively, and were then placed in the cold room. A fifth cheese was ripened in the warm room. The final scoring on these lots showed that the cheese placed immediately in the cold room was the best of all, while the cheese ripened in the warm room was much the poorest of any. The cheese placed directly in the cold room also lost less in weight than the others.

^a Annual Report, Ontario Agricultural College and Experimental Farm, 1899.

^b Annual Report, Ontario Agricultural College and Experimental Farm, 1900.

^c Annual Report, Ontario Agricultural College and Experimental Farm, 1901.

^d Bulletin No. 121, Ontario Agricultural College and Experimental Farm.

The work of 1902 was continued in 1903.^a In this series of experiments a storage room cooled by natural ice to 40° F. was compared with a mechanically refrigerated room carried at the same temperature. Cheese was also carried at 50° F. All cheese, except as otherwise stated, was placed in storage direct from the hoops. Nine lots of cheese were made and some of each stored in each room. For comparison a cheese from each lot was held in the warm room for one week and then placed in the 40-degree ice-refrigerated room, and one cheese from each lot was completely cured in the warm room, which averaged above 60° F. Nine other lots of cheese were made and stored in the same way, except that the cheese carried in the ordinary temperature for one week was placed in the mechanically refrigerated room instead of the room cooled by natural ice. In all of these tests the cheese placed immediately in the 40-degree room was slightly better at the end of the test than any other, while the cheese ripened at the ordinary curing-room temperature was of noticeably poorer quality in both flavor and texture. The cheese held in the warm room for a week was practically as good as that going immediately into storage. There was found to be very little difference in the effects of mechanical and ice refrigeration on the quality of the cheese, the small difference being in favor of the artificially refrigerated rooms. There was less shrinkage in the ice-cooled rooms, because of the higher humidity, which probably amounted almost to saturation. None of the cheese was paraffined. In connection with these experiments it was stated that cheese could be held for a week before going into cold-storage rooms without damage, provided the temperature did not go above 90° F.

The Ontario experiments were continued in 1904.^b Several new features were introduced in this series of tests. Professor Dean tried the effect of varying quantities of rennet and also compared boxed cheese with cheese placed on the shelf and handled in the old way—that is, turned and rubbed occasionally. He also again compared ice and mechanical refrigeration in these tests. Fourteen lots of cheese were made up, seven lots with 3½ ounces of rennet to 1,000 pounds of milk and seven with 6½ ounces of rennet to 1,000 pounds of milk. These were carried at a temperature of 40° F., being divided between the ice-chilled and the mechanically refrigerated rooms. The score of the cheese showed no practical difference in the quality when made from varying quantities of rennet.

For the boxing and shelf test nine lots of cheese were made and were divided between the ice and mechanical storage rooms. Half of the cheese was kept on the shelf, and half was kept in boxes without turning. The results showed a slightly greater shrinkage on the shelf

^a Annual Report, Ontario Agricultural College and Experimental Farm, 1903.

^b Annual Report, Ontario Agricultural College and Experimental Farm, 1904.

and a slightly greater tendency to mold in the boxes. There was no difference in the quality in either case.

Six lots of cheese were made up for temperature experiments. Cheese was carried at 28°, 40°, 50°, and 55° F. The cheese ripened at 40° F. scored slightly higher, but the difference was very unimportant and was well within the limits of probable error of the judges.

For the ice and mechanical storage test thirteen days' make of cheese was used. One cheese from each day's make was held at a warm temperature for one week and then placed in mechanical storage at a temperature of 40° F., and the same plan was followed with regard to the ice storage. Three other cheeses went direct into storage from the hoops, one in the ice storage at 40° F., another in the mechanical storage at the same temperature, and the third in a 50-degree room. When these cheeses were scored, they showed very little difference in quality, as in the previous year's test, the cheese cured at 50-degree being slightly better, and the mechanical and ice refrigeration showing no difference in effects, except in the less shrinkage in the ice-cooled rooms, which was due to the higher humidity.

COMMENTS ON THE WISCONSIN AND THE CANADIAN WORK.

As has been heretofore mentioned, the Wisconsin Station deserves credit for having made the preliminary discoveries which indicated a possible adoption of lower curing temperatures, and it is entitled to further credit for having inaugurated experiments along this line. It is probably true that no two men on the continent were better qualified to have undertaken this pioneer work than Doctors Babcock and Russell. The first experiments were conducted at the station proper, and as a result of this work certain recommendations were made which have not as yet been fully adopted, but which will probably prove to be the basis for the treatment and handling of all cheese in the not-far-distant future. One recommendation was that the cheese be put into cold storage direct from the hoop, and it was pointed out that this would check the development of many undesirable ferments which appear within a few days or weeks after the cheese is made.

This purely experimental work was supplemented by additional tests in a regular cheese factory. This latter work approached very closely actual commercial conditions, and, as stated in the reports of the station, perhaps deserves greater weight than the previous work. In fact, there was an element of weakness in the first work done, because the cheese was made up in small vats, not all of the cheese in one test coming from the same vat, thus leaving a decided possibility for variation in quality.

A number of benefits to be derived from the low temperature were pointed out. It was shown that cheese made from day to day and cured under these conditions showed greater uniformity in quality,

this of course being due to the fact that undesirable qualities had very little opportunity to develop under these conditions. It was also shown that the cheese lost much less in weight when cured at the low temperature. This was a very important point at the time of these experiments. Another point was the longer period for curing and the consequently longer time during which the cheese was fit for consumption. It would appear that this was an important point, but in view of market conditions it is doubtful if this fact of longer keeping is of as great advantage as was at first supposed, except in the carrying of cheese for the winter and spring trade. It is deemed necessary by cheese makers that all cheese of a previous year's make be cleaned up by about April 1 to avoid a financial loss due to the lower prices of the new cheese, which comes on the market about this time and which appears to be just as desirable to the consumer. A few months added to the keeping period may be desirable, but one or two years would not be considered by many dealers.

In the work done at Guelph, Canada, there were two very commendable features, one being the great number of different days' make which was compared. In the experiments for 1904 alone 42 lots of cheese were made up. The other feature was the fact that all of the cheese in a single test came from the same vat of milk. As the milk at Guelph is obtained from herds scattered throughout a small territory—the same condition that prevails in the case of a commercial factory—these experiments should have great weight. It would appear that the only possible opportunity for variation or ground for criticism would be on account of the cheese not being carried in regular cold-storage establishments, such as are found in the larger cities and which are conducted upon a commercial scale.

COMPARISON OF ICE AND MECHANICAL REFRIGERATION.

An interesting feature of the Ontario work was a comparison of the effect upon cheese of ice and mechanical refrigeration. This was a point well worth investigating, especially in the days before paraffining had become general. It is difficult, however, to comprehend how the cheese could be influenced to any appreciable extent by the fact that one room was cooled by ice and another by some other means. The only probable variation in the condition of the atmosphere would be in the relatively higher humidity in the rooms cooled by ice. At the present time, when practically all the cheese that comes into cold storage is paraffined, any variation in the moisture content of the air would have no effect whatever, or certainly none that need be taken into consideration. The cheese used in the Canadian experiments, as well as that used in the Wisconsin work, was not paraffined, and it was thought probable that the humidity would lessen the shrinkage and through this influence the quality. As was brought out in the

experiments, the cheese kept in the ice-cooled rooms did lose a little less in weight, but the quality was the same, as nearly as could be determined by the judges. A little more trouble with mold was experienced in the ice-cooled room, due to the humidity of the atmosphere. Since the adoption of paraffining, it is probable that a high humidity would be undesirable because of the possible effect it might have on the paraffin. This is merely assumed and has no experimental foundation, but it is entirely possible that the effect would be unfavorable.

INCREASE OF COLD-STORAGE PLANTS IN CHEESE DISTRICTS.

The practical application of results obtained by the Wisconsin Station was indicated in the recommendation made by Doctors Babcock and Russell that central curing rooms be built. These rooms were designed to take the place of the ordinary factory curing rooms and were to be situated close enough to a number of factories so that the cheese could be taken from such factories to the curing room every few days. These rooms were to be looked after by competent men and were to be kept at temperatures under 50° F. One such curing room was actually built at La Crosse, Wis., and was in operation for a short while, but through some mismanagement or poor planning was forced to cease operations. The further building of such curing rooms was probably stopped by the great number of cold-storage warehouses, which were soon built in the towns near the cheese districts. In New York such establishments are found at Watertown, Lowville, and Jamestown; in Wisconsin they are found at Sheboygan, Fond du Lac, Plymouth, and many other places situated in or near sections of the State devoted largely to the cheese industry. These storage places did away with the necessity for the centralized curing room, though in fact they are an adaptation of the idea on a slightly different business basis from that which was at first contemplated. The dealers who buy cheese direct from the factories are located near these storage houses, and at Plymouth, Wis., half a dozen of the largest cheese firms in the world have their main offices, though the town itself is only a small country village. This is perhaps the most marked example of the present condition.

With the building of these storage houses near the cheese factories it naturally followed that cheese commenced to find its way from the factories into the hands of the dealers much sooner after leaving the hoop. This tendency has increased until now the cheese is under two weeks of age, as a rule, when placed in storage; in fact, it is as young as the dealers will accept it at the present time, for reasons which will be mentioned hereafter. This is the logical outcome of the whole question of the cold curing of cheese. There will undoubtedly be changes in details, but the main points will probably not be changed under the present conditions. Curing in the cheese factory is a thing of the

past in sections closely connected by rail with towns having cold-storage houses. The tendency is for the dealer to take the cheese closer to the hoop, and anything that will show how this can safely be done will hasten the adoption of the recommendation and idea advanced by Doctors Babcock and Russell—namely, that cheese should go into storage the day it is taken from the press.

COMPARATIVE ADVANTAGES OF COLD AND COOL CURING.

The outcome of the experiments in Canada has been a little different from that of the Wisconsin experiments. In fact there are many things regarding the situation as it is found in Canada which are very difficult to explain. The work done at Guelph would seem to have indicated that cold storage was the only correct way of handling cheese. Canada has a department of agriculture, with a dairy commissioner who has always been actively interested and taken a leading part in the development of the cheese industry of the Dominion. On the basis of results obtained in tests that were carried on in various factories, cooperative cool-curing rooms were recommended. As has been heretofore explained, these rooms were to carry a temperature above 50° F.; in fact, in practice they averaged about 58° F., according to the reports. These rooms were necessarily cooled by artificial means during a part of the year. In advocating this cool-curing system in preference to cold curing, three arguments were advanced. One was that the expense of holding the rooms at the higher temperature is much less than would be required for a temperature of 40° F.; another was that the time required for curing is only about one week longer in the cool rooms than would be necessary in the ordinary factory curing rooms; while the third argument was that in the cool rooms cheese developed a decided flavor which was necessary for the export trade.

On the recommendation of the Canadian department at least three such rooms have been built in as many different sections. They appear to have given perfect satisfaction, and cheese cured in these rooms was of course of a much more uniform quality and the shrinkage much less than with the old conditions of factory curing rooms. The general scheme was to pay for storage about what was saved in the shrinkage. This saving did not quite pay for the actual cost of maintaining the rooms, but it is probable that if the better quality of the cheese due to being cured under such favorable conditions could be taken into consideration the benefits derived would undoubtedly pay or more than pay for the actual cost. A number of factories patronize each of these cool rooms, teams being furnished to collect the cheese practically every day by making a circuit of the factories. This plan gets the cheese into a favorable temperature almost as it comes from the press, and is undoubtedly a desirable feature.

One of the arguments in favor of the cool rooms and which has been urged in this country against the employment of cold storage for curing cheese is based on the fact that perhaps the best cheese made in the course of the season comes from the factories in the latter part of September and during October. In this connection English Cheddar cheese, to which reference is often made, is cured at about the same temperature as would prevail in the American cheese districts in October, which would be about 60° F. This argument is very unscientific to say the least. There are other probable reasons for the superiority of our September and October cheese. This season is especially good for the production of very fine milk; nights are cool and the milk easily kept, and the cows have advanced in lactation until there is a relatively high percentage of fat in the milk. The English Cheddar, the superior qualities of which are probably much due to imagination, is made under almost the same conditions of climate as prevail in this country in the early autumn. The English summers are very cool, giving a fine opportunity for producing good milk; and the quality of the English cheese, if as good as claimed, is undoubtedly due to this fact rather than to any superiority of curing temperature over the regular cold storage.

It is doubtful if the argument advanced concerning the comparative cost of "cool-curing" rooms and "cold-curing" rooms has any material foundation. In theory it would, of course, cost more to hold a room at 40° F. than at 55° F., but considering the amount of cheese that even a small cold-storage house will hold and the relatively small cost per pound for this storing, it is doubtful if the comparative cost would have any great influence. It seems that no figures have been compiled to show what has been the actual cost of storage in the cool rooms per pound of cheese. The Dairy Division of this Department requested such information from the Dominion government, but was told that it was not available. However, prices charged for the storage of cheese in various cold-storage houses in this country were obtained. One storage firm quotes one-fourth of a cent per pound for five months from June 1 and one-half a cent per pound for nine months from June 1. A large Chicago house charges 16 cents per 100 pounds for the first sixty days or any part thereof and 8 cents per 100 pounds for each succeeding thirty days. This amounts to about one-twentieth to one-eighth of a cent per pound per month. This would appear to be such a reasonable charge that it would be difficult for any other system to show any appreciable advantage.

The contention that the comparative difference in the time of curing is considerable does not appear to have any real foundation. In general terms it was claimed that the cheese in the cool-curing rooms required but about one week longer for curing than would be necessary under factory conditions, while it was further claimed that cheese

carried at 40° F. required about four times as long a period for ripening. The latter part of this contention is probably true, as it was shown by the Wisconsin Station through chemical analyses made during the course of ripening that cheese held at 40° F. broke down in four weeks to about the same extent to which cheese carried at 70° F. would break down in one week, and according to the reports of the same station there was a decided difference in the rate of curing of cheese held at 55° and at 65° F.—much more, in fact, than was claimed in the arguments for the cool-curing rooms.

In connection with the claim that the cheese cured in the cool-curing rooms had a more desirable flavor than cheese cured in the cold-curing rooms, there seems to be room for a decided difference of opinion. As has been previously mentioned, the market demand is growing rapidly toward a cheese of mild flavor. This will be mentioned hereafter, but in this connection it may be stated that the scoring of the cheese in the experiments conducted at Guelph was done by well-known Canadian buyers and exporters, and in their opinion the cheese cured at 40° F. was slightly superior in quality to that cured at 60° F.

The Canadian cool-curing rooms attempt to pay expenses by the saving in shrinkage. In cold curing, as now generally practiced in this country, cheese is paraffined as it goes into storage, thus preventing practically all shrinkage. Otherwise the shrinkage would amount to about 1 pound or more in 20, and at 10 cents a pound this saving in shrinkage would be sufficient to carry the cheese in storage for nine months at the prevailing rates.

Evidently one fact that has not been taken into consideration is that a temperature of 55° or 60° F. will not check many undesirable ferments which may occur in the ripening cheese. It was emphasized by Babcock and Russell that one of the advantages in a cold-curing room lay in the fact that many undesirable qualities due to conditions which existed at the time of making could be almost entirely overcome by the use of very cold temperatures in curing. This would not hold true for the cool-curing rooms. It would be impossible, owing to these factory conditions, to get such an even quality of cheese in the cool rooms as could be secured by the use of the lower temperatures.

COOPERATIVE WORK BY THE DEPARTMENT OF AGRICULTURE AND STATE STATIONS.

At the suggestion of the Wisconsin Experiment Station the Department of Agriculture, through the Dairy Division of the Bureau of Animal Industry, in 1902 entered into a cooperative arrangement for conducting some commercial experiments on the cold curing of cheese.^a The station at first contemplated that all the work should be

^aBulletin No. 49, Bureau of Animal Industry.

undertaken in that State and the cheese made in factories over which the station could exercise a certain degree of control. Upon the suggestion of the Dairy Division, however, the work was broadened so as to include the New York State Station at Geneva, and was further extended to include cheese from a number of different States, namely, Pennsylvania, Ohio, Michigan, Illinois, and Iowa. Storage facilities for the Eastern States were secured in New York City and for the Western States at Waterloo, Wis.

Different types and styles of American cheese were gathered from the factories scattered throughout the States mentioned. This cheese was stored, without paraffining, at 40°, 50°, and 60° F. Three judges scored the cheese in charge of the Wisconsin Station, and a different set of three judges scored the cheese in charge of the New York Station. Mr. Baer, expert cheese maker for the Wisconsin Station and university, made periodical inspections of the Waterloo cheese in addition to the regular scoring by the judges. The Wisconsin cheese was scored at the end of three months and again at the end of five months. The score showed a slight difference in favor of the cheese kept at 40° F. This difference was greater at the end of five months than at the end of three months, though at neither time did the average variation reach a total of 4 points out of a possible 100. The market value was placed on the cheese by the judges and showed slightly in favor of the cheese stored at 40° F.

The cheese in charge of the New York Station was scored at five different times—when fresh, at the end of two months, at the end of four months, at the end of six months, and again in eight months. The cheese held at 60° F. was sold at the end of four months, as it had commenced to deteriorate. The lowest score was given to the cheese held at 50° F. at the end of six months. The cheese held at 40° F. gave a slightly higher maximum scoring, and, as had been demonstrated in previous experiments, remained in good condition very much longer.

In addition to this regular work, one of the New York City cheese dealers furnished a quantity of cheese to be used in paraffining tests. Half of this was paraffined and half remained unparaffined. Both lots were divided between the 40°, 50°, and 60° rooms. The results showed a decided saving in shrinkage in the paraffined cheese and no effect on quality.

There are several things connected with the scoring in New York City which are a little difficult to understand. The cheese when green scored practically as high as when thoroughly ripened. No explanation was offered, and evidently none was called for on this point, but it is difficult to understand why such a high score should have been given at that time. It is impossible for cheese fresh from the press to have the characteristics of a desirable texture. It has no developed flavor

and its qualities at best must have been purely negative. Another point in connection with the scoring was the fact that such small differences in quality were noted between the different lots of cheese. The cheese was selected from a number of different factories, was subject to adverse influences before arriving in New York, and it is improbable that it could have been so nearly of the same quality. The explanation of this point, if there be any explanation, is probably that all three judges were commercial men, that all of the cheese, according to commercial standards, was well above the quality demanded for the highest prices, and consequently the judges did not discriminate to any extent within these limits. From a commercial standpoint the scoring and its results were undoubtedly entirely satisfactory, but from an experimental point of view it would appear that there was something more to be desired.

Another point in connection with this cooperative work as affecting both New York and Wisconsin and which might be considered subject to some criticism was the fact that the cheese for these experiments was obtained in quantities varying from 500 to 1,000 pounds from each factory. It is extremely improbable that in the case of the larger amounts coming from a single factory the cheese was all made in one vat. It would seem that a thoroughly satisfactory test would have required that the cheese from each and every factory should be divided between the different temperatures selected for storing on the basis of the vat in which the cheese was made—that is, that each vat of milk should have been considered by itself in dividing the cheese for the different temperatures of storing. Two vats of milk on the same day can easily vary as much in quality as the milk of widely separated days. It is a well-known fact that where more than one vat is run in a factory on the same day cheese of the very highest quality may be made in one vat and of exceptionally poor quality in another. In these experiments, in a number of cases at least, it appears as though the cheese from each factory was lumped together without reference to whether it was made in one or two vats, and it is quite likely that some variation in results was due to this fact, as such could easily have been the case had the cheese varied as much in quality as it frequently does under such conditions.

This cooperative work was impaired somewhat, in the writer's opinion, by the insistence of the Department of Agriculture that the cheese should be gathered from so many different sources. It was, of course, impossible to supervise or control the making of the cheese under such conditions. Then, too, such long shipments were required in many instances that the cheese was several days old before going into storage. There is no question but the work would have been much more valuable could it have been done in one locality where some direct observations could have been made on the manu-

facture. Care was used in selecting the factories from which the cheese was to come, but this did not overcome the weak points in the general plan.

MINOR EXPERIMENTS BY THE IOWA AND NEW YORK STATIONS.

In addition to the more extensive experiments conducted in Wisconsin and Canada and the cooperative work in which the United States Department of Agriculture took part, some minor work on the effect of temperature in cheese curing has been done at the Iowa Station^a and at the New York State Station.^b These experiments were concluded before the regular cold-storage work was undertaken in Wisconsin and Canada.

The work in Iowa was partially in cooperation with Canada. Cheese was shipped from Ontario and cured at a temperature of about 60° F. Other cheese was cured at 55° F. In another test, fresh cheese was held at 90° F. for a few days after making and then cured at a lower temperature. It was concluded from these experiments that the exposure to a high artificial temperature for several days before going into the colder rooms had no bad effect.

In the New York State Station test temperatures of 55°, 60°, 65°, 70°, 75°, and 80° F. were employed. The cheese cured at 55° F. scored 7 points higher than that cured at 65° F. and above.

Besides the conclusion announced as a result of the Iowa experiments in cool curing, to the effect that cheese could be held at a relatively high temperature several days before going into the colder rooms without injury, this same statement was made as a result of some of the Canadian experiments, and was repeated by the Wisconsin workers in connection with their recommendation for a central curing plant. Mention has previously been made of the recommendation of the Wisconsin Station that cheese should go into storage direct from the hoop, and it would appear that these statements were rather inconsistent. There is no doubt that all these investigators were in error in their statements, as a general proposition, that cheese could be held at a high temperature even for a few days without injury. It might be true of cheese which had been made from pure milk, under exceptionally good conditions; but where undesirable flavors have a tendency to develop, any period of high temperature, no matter how short, after leaving the press would undoubtedly give undesirable results. The fact that in many cases the cheese which went direct into storage was given a higher score than that which remained in the ordinary curing rooms for from one to two weeks is proof of this statement. Although some cheese can stand

^a Bulletin No. 57, Iowa Experiment Station.

^b Bulletin No. 184, New York State Station.

a warm temperature without injury and could even be cured at a temperature of 70° F. and come out with an almost perfect score, as has been shown on many occasions, this is no proof that the warm temperature is desirable for curing.

REPORT OF RECENT EXPERIMENTS BY THE DEPARTMENT OF AGRICULTURE.

The Dairy Division thought it wise to conduct further experiments in cold curing, as the only commercial test made in which the Department cooperated was so unsatisfactory that it did not lessen the desirability for further work of this nature. Again, market conditions had changed so radically that the work performed and the conclusions drawn therefrom, which might have been entirely satisfactory a few years ago, would not apply to present conditions.

A number of questions have been advanced by dealers who utilize cold storage in regard to recommendations made on the basis of previous experiments to the effect that cheese should go into storage direct from the hoop. The dealers have been afraid to adopt this view entirely, though the general method of handling is perhaps growing slowly in this direction. Perhaps the reason advanced by most dealers against buying perfectly fresh cheese is that it is impossible to tell, when a cheese is inspected too young, just how it will develop. Any bad qualities, or at least a few of the bad qualities, which are likely to show in the cured product can not be detected in a cheese a day old. The most important of these possibly injurious qualities is in connection with the development of acid, though undesirable flavors would perhaps be mentioned by many of the dealers. It is well known that a high-acid cheese appears perfectly normal as it comes from the press, and the fact that there is too much acid does not show until the cheese is at least a week old or even two weeks old. In certain seasons of the year this is a fault that is very likely to occur at times in all factories, and as a high-acid cheese brings a much lower market price the dealers have a just reason for being suspicious of fresh cheese. The contention that other faults may develop will not be so difficult to overcome. It has already been proven that cold storage checks a great majority of the undesirable ferments, and a fault which is not noticeable in the green cheese will not be likely to develop after the cheese is placed in storage at a temperature too low for bacteriological changes. This needs to be demonstrated perhaps a little further and to be impressed upon the minds of the dealers. The work heretofore conducted has been almost without exception with a very high-grade product. In previous tests the cheese ripened at the ordinary curing-room temperatures rated above the requirements for the highest market price, and because of this the experiments did not demonstrate the great advantages of the early application of cold temperatures.

TRADE CONDITIONS AND PRACTICES.

Before undertaking the work covered by this report a very careful investigation of conditions affecting the cheese industry was made. This investigation showed that the practice of putting cheese into cold storage before it was cured had become almost universal. Very few factories throughout the cheese districts of New York and Wisconsin keep the cheese on hand for a longer period than two weeks. This means that the ripening process has progressed very little before the cheese goes into storage, and the greater part of the curing, if it takes place at all, must be done at the low temperature.

There was, however, within narrow limits, considerable variation in the age at which the cheese was placed in storage. Some dealers were willing to take it when one week old, while others insisted that it be two weeks old. The time varied somewhat, however, with the market demands and the season of the year. It was an open secret that at certain periods when cheese was scarce and the demand insistent cheese would be taken when four days old or even less, though this was not put into storage, but as a rule was shipped immediately to the consumer.

The temperatures employed at the different storage houses showed considerable variation. It appeared that at some a temperature as low as 30° F. was used, while at others the temperature employed was slightly above 40° F., a majority ranging from about 34° to 36° F.

No reason could ever be obtained why any one establishment employed a particular temperature, the managers of those using the lower temperatures simply stating that the temperature was as low as possible without danger of freezing the cheese.

PLAN OF THE WORK.

In planning for the work in view, the points brought out in previous investigations served as a basis for the experiment. As the custom of curing cheese in the factory curing room had practically ceased to exist, there was no reason for making any particular effort to demonstrate the superiority of cold curing over the old method. It seemed to have been sufficiently demonstrated both in this country and in Canada that a temperature of 50° F. or lower was the most satisfactory for cheese ripening, so no particular weight was placed on any further demonstration of this point, though a few cheeses were carried in the factory curing room to show what a long exposure to high temperatures might develop in a cheese which would otherwise have been of a high quality.

As the temperatures employed by different storage houses varied from about 30° to 40° F., two temperatures were selected for our work—namely, 32° and 40° F., and as cheese is placed in storage at

various ages, in these experiments cheese fresh from the press and at one and two weeks of age was stored in rooms of different temperatures.

There has been considerable discussion as to the effect on ripening of different styles, shapes, and sizes of cheese. It seems to have been demonstrated in Canada on one or two occasions, and also in the cooperative experiments hereinbefore mentioned in which the Dairy Division took part, that the size of the cheese had very little influence on its quality. There is a popular belief, however, that the large Cheddar cheese weighing from 60 to 100 pounds develops a better texture and perhaps a better flavor than smaller types. This is extremely doubtful when considered in the light of actual knowledge. The size of the cheese was given no consideration, as it was believed that it would have no important bearing upon this general problem. If cold storage benefits a small cheese, it should certainly benefit a large one, and vice versa. The only exception that could possibly be made to this statement would be in connection with the possible variation in water content of the small and large types. The small cheeses are as a rule not subjected to so great pressure as are the large ones, but even if this were not the case it is doubtful if the amount of pressure applied plays any important part in the water content of the cheese. Analyses go to show that small types of cheese possess about the same percentage of water as large types. For the experiments the "Daisy" style of cheese was chosen. It is about halfway between the extremes of size represented by the old-fashioned "Cheddar" and the "Young America." It is, moreover, an extremely popular size, often bringing in the regular market as high as a cent a pound more than the other styles. It is shaped about like the old styles of cheese, and is of sufficient size to permit heavy pressure.

In selecting a place for the experiments the ground was gone over carefully and a number of things were taken into consideration. Previous work has usually been carried out with the factory and place of storage so widely separated that accurate work was impossible. It was impossible for the man in charge of the work to look after the details of the storage, and the distance did not permit of cheese being taken direct from the hoop and put into storage the same day.

In the first place it was desired that this work should be put on a commercial basis as far as possible and that the cheese should be made in a commercial factory representative of a large number of factories. To do this required that the work of both making and storing should be done in some rural district. But two suitable locations could be found—Utica, N. Y., and Plymouth, Wis. The storage plants at these points employed mechanical refrigeration, which permitted variation in temperature. A number of storage establishments in both Wisconsin and New York used natural ice and were not arranged to allow any great variation in the temperature of different rooms or

to secure constant temperature in the same rooms. The Plymouth storage warehouse is situated in the heart of a region devoted almost exclusively to the cheese industry. Perhaps 25 factories of large size are to be found within a radius of 5 miles. This was considered the best location, and very satisfactory arrangements were made with the proprietors of the storage establishment located at that place. The factory selected was only 3 miles from the storage house, was the largest factory in the district, receiving 15,000 pounds of milk per day, and was owned and operated by an unusually successful cheese maker. The milk received at this factory was of about the same quality and sanitary condition as would be found in a majority of the factories in the district. The factory itself was not a model, as that term would ordinarily be understood, but it was a good, practical establishment, with good equipment and satisfactory sanitary surroundings. The maker was a man familiar with the cheese business in nearly every phase, and was able to give most excellent advice and assistance.

The Wisconsin Dairymen's Association was very naturally interested in the work that was being conducted within the State, and when requested gave the services of its traveling cheese instructor on two occasions to serve as a check on the work being done. This was thought desirable in order to make the cheese representative of the whole State rather than of one locality or factory.

In these experiments it was planned to make cheese four days each week, low-rennet cheese being made one week and high-rennet cheese the next, and then a week intervening in which no cheese was made and the work in the storage rooms looked after. This plan was followed except on two occasions, when the cheese was made only three days in the week. Fifteen lots of low-rennet cheese and eleven lots of high-rennet cheese were made up, being in all twenty-six days' make.

The first lot of cheese was made June 19 and the last lot in the regular line of experiments August 24. It would have been more desirable to have commenced this work about the 1st of June, but, unfortunately, arrangements could not be completed by that time. However, the experiments covered the greater part of the storage season, and were therefore of sufficient duration to be representative of the cheese which is held in storage throughout the summer and fall.

DETAILS OF MANUFACTURE, STORAGE, AND CURING.

LOW AND HIGH RENNET.

As had been done in some of the previous work both in Wisconsin and in Canada, cheese was made up for these experiments with different quantities of rennet, the normal amount of 3 ounces to 1,000

pounds of milk being used for part of the work and double this amount for the remainder. This was thought desirable, as under the present market conditions much of the cheese is rushed from the factory to the consumer, and with our present knowledge of cheese as a food product it is desirable that at least some degree of ripening should occur before the cheese is eaten. It is entirely possible that a great deal of cheese, especially in the early spring, gets into the hands of the consumer at two weeks after making. Ordinarily there would be very little chance for breaking down or ripening to occur within this period. It has been demonstrated that rennet hastens this process, and it is quite desirable, or at least appears to be desirable, to have some means for hastening the ripening either when the cheese goes upon the market so young or when it goes into storage direct from the hoop, as the cold temperature of course checks the ripening process. Unfortunately there was no opportunity to compare the exact rate of ripening of the high and low rennet cheese. This has been done, however, in Wisconsin, and it was demonstrated thoroughly that cheese made with double the usual quantity of rennet broke down much faster than that with the ordinary quantity. The cheese in our experiments was closely observed and the rate of ripening was determined, so far as this could be done without chemical analysis.

If the use of larger quantities of rennet ever becomes customary, it will be desirable to have some data to show the effect of the rennet on the quality of the cheese as well as on its rate of ripening. This, of course, is demonstrated more or less thoroughly in the work here presented.

SELECTION AND HANDLING OF MILK AND CURD.

As has been noted before, the cheese for these experiments was made on a commercial scale. It was made up entirely in a large vat holding about 5,000 pounds of milk, and in no case were any small experimental lots manufactured. At first there was an attempt made to select milk that would make up a good cheese. This was done by watching the development of the milk in the three vats in the factory, and about the time the whey was drawn selecting the most promising curd. This was discontinued, however, after a few days, and the plan then followed was to watch the vats from day to day and take the contents of the vat that appeared to be doing the best for a continued period of time. This resulted in getting a few lots of cheese that were not the best, as shown in the curd; a number of the curds were tainted, and in one or two instances the curds were slightly gassy. This was not undesirable, however, from an experimental point of view, for any benefits that may be derived from storage are likely to be in its application to what might otherwise be a poor cheese. In fact, this is a line of work that the Dairy Division has in view for the future.

The curds for these experiments were cooked a little more firmly than was the custom in most of the cheese made in this factory. The tendency in the factories of both Wisconsin and New York is to make a cheese as soft as possible, or, what is more to the point, to incorporate all the water possible in the curd, as the reputation of the maker at the present time depends perhaps more largely upon the yield secured than on the quality, and consequently a large number of makers pay but little attention to quality and considerable attention to means for securing quantity. However, for the experiments under discussion, quality was considered first and quantity last. The cheese was probably not cooked quite as firm as was the custom among cheese makers ten or fifteen years ago, but it was carried far enough to insure a product that would stand up in the warmest weather, and which from every point of view would be considered a very satisfactory article.

All the cheese was made according to what is known as the Cheddar process. The acid was allowed to develop to a certain point before the milk was set and to develop further to a certain degree, as shown by the iron test, before the whey was drawn. After the first few weeks of the making an acidimeter was installed and used constantly in parallel tests with the hot iron. The curd was cooked and allowed to break down or mellow to about the extent required by most cheese makers. It was ground in a mill with knives for cutting rather than tearing the curd. It was then allowed to stand until it stopped draining and reached about the proper condition, and was then rinsed with warm water and salted at the rate of about 2 to 2½ pounds of salt to 1,000 pounds of milk.

METHOD OF STORING AND CURING.

As before stated, the cheese was made up in the "Daisy" style as being perhaps the most popular form of cheese made in the Northwest. From the vat of milk selected about 14 cheeses of this style were taken every day. Of these 2 were allowed to ripen in the factory curing room, 2 were placed at once in the 32-degree room, 2 were placed at once in the 40-degree room, 2 were placed in the 32-degree room and 2 in the 40-degree room at the end of one week, and 2 were placed in the 32-degree room and 2 in the 40-degree room at the end of two weeks. They were divided in pairs in this manner so as to be sure of having duplicates to take the place of any cheese which might be injured or possibly lost. As has been mentioned, the factory was located near the storage house, and it was possible to get the green cheese into storage exactly at the times specified. Cheese taken from the hoop in the morning was put in the storage house in the afternoon.

PARAFFINING.

All of the cheese put into storage at the end of one and two weeks was paraffined, the factory being provided with an outfit for this purpose. The cheese which was immediately placed into storage was not paraffined until from 3 to 5 weeks old, as it is popularly believed among dealers that cheese direct from the press can not be paraffined without injury to quality. The cheese remaining in the factory curing room was not paraffined. Some difficulty was encountered in the paraffining work with the cheese which remained in storage for several weeks before paraffining. This period had given the mold time to commence developing, and when the cheese was paraffined in a vat belonging to one of the dealers located near the storage plant the cold surface of the cheese, by cooling the paraffin, prevented the mold spores from being killed, and the mold developed after the cheese was returned to storage. In addition the cold surface caused an unusually heavy white coating of paraffin to stick to the surface, and, the growing mold ruining the surface of the cheese, the combination gave the cheese a bad appearance. After the first few lots were paraffined in this manner the cheese was held in the hot paraffin until the surface had time to become warm. This killed the mold spores, made a much thinner coating, and altogether overcame the previous trouble.

DETAILS OF MAKING THE CHEESE.

A very careful record of all experimental data was kept from the time the milk entered the factory until the cheese went into storage. This record is presented in tabulated form, as follows:

TABLE I.—Data of making the cheese.
LOW RENNET (3 OUNCES TO 1,000 POUNDS OF MILK).

Lot.	Rennet test.	Time to cutting.	Temperature of cooking.	Time to reach cooking temperature.	Time to drawing.	Acid.	Iron test.	Time to grinding.	Acid.	Iron test.	Time to salting.	Iron test.	Degree of firmness to which cooked.	Flavor.	Remarks.
	Minutes.	Minutes.	° F.	Hours.	Hours.	Per ct.	Inches.	Hours.	Per ct.	Inches.	Hours.	Inches.			
1	3:00	40	99	1:40	2:20	.....	$\frac{1}{8}$	4:20	.....	$\frac{1}{2}$	5:20	$1\frac{1}{2}$	Medium.....	Clean.....	Close body.
2	2:45	30	100	1:30	2:15	.....	$\frac{1}{8}$	4:15	.....	1	6:30	$1\frac{1}{2}$	Firm.....	do.....	Do.
3	3:00	35	101	1:50	2:15	.....	$\frac{1}{8}$	4:45	.....	$\frac{1}{2}$	6:05	.....	Soft.....	do.....	Do.
4	3:00	35	100	1:35	2:10	.....	$\frac{1}{8}$	5:10	.....	$\frac{1}{2}$	6:10	$1\frac{1}{2}$	Firm.....	do.....	Open body.
5	3:00	40	101	1:25	2:40	0.22	$\frac{1}{4}$	5:10	0.80	1	7:10	.....	do.....	do.....	
6	3:45	40	99	1:40	3:10	.20	$\frac{1}{4}$	5:10	.70	1	6:10	.....	Very firm.....	do.....	A very fine curd.
7	4:15	35	98	1:35	3:15	.20	$\frac{1}{4}$	5:35	.80	1	7:15	.....	do.....	do.....	
8	4:15	35	98	1:35	3:15	.20	$\frac{1}{4}$	5:35	.80	1	7:15	.....	Firm.....	do.....	Appeared wet on the rack.
9	3:20	35	99	1:20	2:50	.15	$\frac{1}{8}$	6:05	.75	$\frac{1}{2}$	7:05	.....	Soft.....	do.....	Curd becoming firm on the rack.
10	3:30	35	99	1:25	2:50	.16	$\frac{1}{8}$	4:50	.75	$\frac{1}{2}$	5:50	.....	do.....	do.....	Appeared whey soaked on the rack.
11	3:30	35	99	1:20	2:45	.16	$\frac{1}{8}$	5:15	.75	$\frac{1}{2}$	6:15	.....	Firm.....	do.....	
12	3:50	35	99	1:20	2:55	.16	$\frac{1}{4}$	5:25	.80	1	6:55	.....	do.....	Tainted.....	
13	3:40	40	98	1:20	2:15	.16	$\frac{1}{8}$	4:45	.70	1	5:45	.....	Medium.....	Clean.....	A fine curd.
14	3:40	40	99	1:20	2:40	.15	$\frac{1}{4}$	5:10	.75	$\frac{1}{2}$	6:40	.....	Firm.....	Badly tainted.....	Had pinholes.
15	3:15	40	99	1:10	3:25	.15	$\frac{1}{4}$	6:10	.75	1	7:10	.....	do.....	Clean.....	A very slow-working curd.
16	3:00	30	99	1:00	1:45	.16	$\frac{1}{4}$	4:15	.83	$\frac{1}{2}$	5:45	.....	do.....	Soap taint.....	Pinholes, fast working.

HIGH RENNET (6 OUNCES TO 1,000 POUNDS OF MILK).

1	3:30	30	100	1:30	2:30	0.17	$\frac{1}{8}$	5:45	0.70	1	6:45	$1\frac{1}{2}$	Firm.....	Clean.....	
2	3:00	25	101	1:15	1:55	.20	$\frac{1}{8}$	4:15	.60	$\frac{1}{2}$	5:15	1	do.....	do.....	
3	3:10	20	99	1:15	2:50	.20	$\frac{1}{4}$	5:20	.70	1	6:20	$1\frac{1}{2}$	Very firm.....	do.....	Appeared soft and moist on rack.
5	3:20	25	100	1:25	2:35	.16	$\frac{1}{8}$	4:55	.60	1	6:25	.....	Firm.....	do.....	Appeared wet on rack.
6	3:10	25	100	1:25	2:05	.18	$\frac{1}{8}$	3:35	.70	1	5:05	.....	Medium.....	do.....	
7	3:45	25	100	.55	2:25	.17	$\frac{1}{8}$	5:10	.75	$\frac{1}{2}$	6:40	.....	Firm.....	do.....	
8	3:30	25	99	1:15	3:10	.16	$\frac{1}{8}$	5:40	.75	$\frac{1}{2}$	7:10	.....	do.....	do.....	Very dry.
9	4:00	25	100	1:00	2:55	.16	$\frac{1}{8}$	6:55	1.00	$\frac{1}{2}$	8:25	.....	Very firm.....	Acid taint.....	Became very soft on rack.
10	3:40	22	98	.52	2:22	.15	$\frac{1}{8}$	4:52	.80	$\frac{1}{2}$	5:52	.....	Firm.....	Clean.....	Very fine curd.
11	3:40	25	98	1:00	2:25	.16	$\frac{1}{8}$	4:55	.80	$\frac{1}{2}$	5:55	.....	do.....	do.....	Do.
12	3:45	25	99	1:00	2:55	.16	$\frac{1}{8}$	5:25	.75	$\frac{1}{2}$	6:25	.....	Very firm.....	do.....	Do.

It is understood by cheese makers that milk develops so differently from day to day, or even for the same day in different vats, that it is impossible to make an exact schedule of treatment which would apply to every lot of cheese made. Only one factor was constant, and that was the temperature of setting the milk, which was always exactly 86° F. The rennet test of the milk was always made before setting, and the milk reached about a certain degree of ripeness depending upon the way it had been developing. The regular Marshall rennet test was used, but instead of timing it by degrees as is customary it was timed by a watch in minutes and seconds, which on the whole was much more exact and satisfactory. The table shows that the variation in the rennet test was from two minutes and forty-five seconds to four minutes and fifteen seconds. This wide range was not accidental, but was due to the fact that the milk was ripening at different rates at these different periods. The time from setting to cutting varied with the low-rennet cheese from thirty to forty minutes and with the high-rennet cheese from twenty-two to thirty minutes. The cheese was cut when the stage of coagulation adopted by most cheese makers was reached. It is impossible to describe this stage intelligibly, but it is well known to practical cheese makers. The temperature of cooking varied from 98° to 101° F. The vats in which the cheese was made had mechanical agitators, which required a little higher cooking than under the old method of stirring by hand and with rakes. The time for cutting, cooking, drying, and salting is calculated from the time of setting, so that under the headings for time of grinding and time of salting six hours and fifty-five minutes or five hours and thirty minutes, as the case may be, means that that length of time had elapsed since the milk was set. The time for drawing the whey was regulated by the acid test after the first week, though as a check the iron test was made at the same time. The acid was allowed to develop about as high as was safe without causing an acid cheese. The time of grinding was regulated by the condition of the curd, and at this time also the acid and iron tests were made. Salting was likewise regulated by the condition of the curd. The other columns of the table devoted to firmness, flavor, and remarks will be taken up in discussing individual lots of cheese in connection with the scores.

TREATMENT OF FACTORY-CURED CHEESE.

The first part of the cheese kept in the factory curing room was held until it had about reached its prime condition, when it was put into the 32-degree room and held there until all the factory-cured cheese was ready for scoring. As heretofore stated, the factory curing was not considered an important feature of the experiment, though there were several points brought out in the development of flavors in this factory-cured cheese that were of great interest in connection with

future work contemplated by the Dairy Division. It was not considered of sufficient importance to warrant calling together the regular judges for this work, and so only one man inspected this cheese. Further, it was not regarded of enough importance to warrant taking up the time of this man for more than one day, on which all of the cheese was scored. This of course made the first cheese manufactured considerably older than the last, and it introduced a disturbing factor in the putting of the first cheese into the 32-degree storage room. However, as fine distinctions in the comparative quality of this lot of cheese were not desired, the information received was all that was wanted.

THE JUDGES AND THE SCORING.

Mr. U. S. Baer, assistant dairy and food commissioner for Wisconsin and formerly cheese expert for the university and experiment station, scored the factory-cured cheese. He also assisted in the scoring of the cold-storage cheese, the other two judges being Mr. C. A. White, of Fond du Lac, Wis., and Mr. I. W. Steinhoff, of Stratford, Canada. Mr. White was unanimously indorsed for this work by the cheese dealers of Plymouth and Sheboygan and was widely recommended by persons connected with the cheese industry of the State. Mr. Steinhoff is an exceptionally well-known cheese man in Canada, doing a large business and having been connected with the scoring in the experiments conducted at Guelph. These three men made a very satisfactory combination, as all had spent many years in handling cheese and each was an expert in his particular line. Mr. Steinhoff represented the Canadian idea and was an authority on export cheese, and Mr. White was perhaps as well acquainted with and as able to anticipate the popular taste for cheese in the United States as any other dealer. These two men viewed the subject largely from a commercial standpoint, while Mr. Baer, who had been connected with the experimental work of the Wisconsin Station, was well qualified to represent the educational or experimental phase.

The cheese was of course not scored as it went into storage. The notes on the condition of the curd and the way the cheese was made would be far more accurate as an indication of the condition and quality than any expert scoring of cheese fresh from the hoops could possibly be. Moreover, as all of each lot came from one vat, it was of course identical and required no inspection for the purpose of properly dividing it and placing it into different storage rooms. Only one regular scoring was attempted. This perhaps may be open to criticism, but in the opinion of the judges at the time the scoring was done it was quite evident that the cheese had just about arrived at its prime condition. Some of the cheese held for two weeks in the factory curing room and then placed in the 40-degree room had advanced a little too far, in the opinion of one of the judges, and was marked off

accordingly. On the other hand, the cheese which went direct into the 32-degree room from the hoop was sometimes a little too mild to suit the other judges, so the differences about balanced themselves in this respect. In previous tests made at other places a number of scorings had been made, but it was impossible to show from an inspection of the records just what was gained by this extra work and expense.

EFFECT OF PARAFFINING AND TEMPERATURE ON WEIGHT.

The greater part of the cheese was weighed, the only exception being with the first lots, which went into the cold rooms direct from the hoop, as the scales for use at the storage house, though ordered in ample time, had not arrived. A good pair of scales was in use at the factory, and all the cheese paraffined before going into storage was weighed. The cheese was weighed at three different periods—as it came from the press, at the time it was paraffined, and finally at the time it was scored. The weights of the duplicates only are given in the following table, as the plugging made a difference in the weight of the cheese plugged for scoring:

TABLE II.—Weights of cheese at different periods.

LOW RENNET.

Lot.	Factory cured.		In 32-degree room from hoops.			In 40-degree room from hoops.			In 32-degree room at one week.			In 40-degree room at one week.			In 32-degree room at two weeks.			In 40-degree room at two weeks.		
	Fresh from press.	When ripe.	Fresh from press.	When paraffined.	When scored.	Fresh from press.	When paraffined.	When scored.	Fresh from press.	When put in stor-age.	When scored.	Fresh from press.	When put in stor-age.	When scored.	Fresh from press.	When put in stor-age.	When scored.	Fresh from press.	When put in stor-age.	When scored.
	<i>Lbs. oz.</i>	<i>Lbs. oz.</i>	<i>Lbs. . 2.</i>	<i>Lbs. oz.</i>	<i>Lbs. oz.</i>	<i>Lbs. oz.</i>	<i>Lbs. oz.</i>	<i>Lbs. oz.</i>	<i>Lbs. oz.</i>	<i>Lbs. oz.</i>	<i>Lbs. oz.</i>	<i>Lbs. oz.</i>	<i>Lbs. oz.</i>	<i>Lbs. oz.</i>	<i>Lbs. oz.</i>	<i>Lbs. oz.</i>	<i>Lbs. oz.</i>	<i>Lbs. oz.</i>	<i>Lbs. oz.</i>	<i>Lbs. oz.</i>
1	19 3	17 5	19 14	.....	19 2	19 11	.....	18 15	19 7	18 15	18 14	19 13	19 5	19 2	19 6	18 9	18 8	19 8	18 13	18 9
2	19 12	17 14	.....	.....	.....	.....	.....	.....	19 13	19 7	19 6	19 13	19 7	19 3	19 12	19 1	19 1	19 8	18 12	18 10
3	19 10	17 13	.....	.....	.....	.....	.....	.....	19 15	19 8	19 7	19 12	19 4	18 15	19 3	18 4	18 4	19 12	18 12	18 9
4	19 14	18 0	.....	.....	.....	.....	.....	.....	19 10	19 4	19 4	19 6	19 1	18 15	.....	.....	.....	.....	.....	.....
5	19 4	17 12	.....	.....	.....	.....	.....	.....	19 14	19 1	18 14	19 10	19 3	18 14	19 10	18 15	18 13	19 3	18 8	18 2
6	19 8	17 13	.....	.....	.....	.....	.....	.....	19 7	18 15	18 14	19 8	19 0	18 12	19 7	18 9	18 8	19 6	18 8	18 4
7	19 6	17 14	.....	.....	.....	.....	.....	.....	19 7	18 15	18 14	19 3	18 11	18 7	19 6	18 11	18 3	19 5	18 8	18 4
8	19 9	18 0	.....	.....	.....	.....	.....	.....	19 8	18 15	18 14	19 9	19 1	18 12	19 10	18 15	18 13	19 11	18 15	18 9
10	19 11	18 9	19 12	19 4	19 4	19 6	18 15	18 14	19 9	.....	19 0	19 9	19 3	18 12	19 7	18 11	18 8	19 11	18 14	18 11
11	19 7	18 9	19 13	19 7	19 7	19 10	19 4	19 4	19 10	19 3	19 2	19 9	19 2	19 2	19 6	18 12	18 11	19 5	18 9	18 6
12	19 10	18 12	19 5	18 15	18 15	19 8	19 2	19 2	19 0	18 8	18 7	19 2	18 10	18 5	19 4	18 8	18 6	19 6	18 10	18 6
13	18 8	17 15	19 7	18 12	18 10	19 10	19 2	19 2	19 9	19 2	19 1	19 12	19 4	19 1	19 7	18 11	18 10	19 9	18 14	18 11
14	19 11	19 0	19 9	18 15	18 13	19 8	19 4	19 3	19 9	19 4	19 2	19 13	19 8	19 7	19 8	18 14	18 14	19 13	19 2	19 0
15	19 14	18 15	19 14	19 3	19 2	19 15	19 10	19 8	19 9	19 1	19 0	19 13	19 5	19 4	19 8	18 13	18 12	19 14	19 2	19 0
16	19 11	18 15	19 12	19 2	19 0	19 7	19 1	19 0	19 11	19 2	19 2	19 12	19 2	19 0	19 11	18 14	18 14	19 9	18 13	18 11

HIGH RENNET.

1	19 13	18 1	.....	.....	.....	.....	.....	.....	19 10	19 3	18 15	19 11	19 4	18 14	19 13	19 0	18 14	20 1	19 4	19 1
2	19 11	18 1	.....	.....	.....	.....	.....	.....	19 13	19 4	19 2	19 11	18 15	18 12	19 13	19 2	19 0	19 11	19 1	18 11
3	19 6	17 12	.....	.....	.....	.....	.....	.....	19 4	18 13	18 11	19 1	18 6	18 4	19 2	18 6	18 4	19 1	18 4	18 4
5	19 9	18 11	19 14	19 5	19 0	19 7	19 1	19 1	19 7	19 2	18 14	19 12	19 6	19 6	19 9	18 14	18 13	19 6	18 12	18 9
6	19 12	18 10	19 6	18 14	18 14	19 12	19 5	19 5	19 12	19 6	19 6	19 8	19 1	19 1	19 15	19 4	19 3	19 13	19 2	18 15
7	19 10	18 10	19 9	19 2	19 0	19 12	19 2	19 0	19 10	19 3	19 2	19 11	19 5	19 1	19 10	18 14	18 13	19 12	19 0	18 14
8	19 13	18 12	19 11	19 4	18 13	19 13	19 3	18 15	19 15	19 8	19 7	19 13	19 6	19 4	19 9	18 14	18 13	19 12	19 2	18 12
9	19 0	18 2	19 10	19 3	19 1	19 6	19 0	18 14	19 4	18 13	18 9	19 5	18 15	18 12	19 16	18 11	18 8	19 8	18 14	18 9
10	19 10	18 12	19 6	18 9	18 8	19 6	19 2	19 1	19 2	18 11	18 9	19 3	18 13	18 11	19 1	18 7	18 4	19 5	18 11	18 6
11	19 11	18 13	19 4	18 14	18 12	19 7	19 1	18 14	19 8	19 1	18 15	19 8	19 2	19 0	19 2	18 6	18 4	19 8	18 11	18 6
12	19 10	18 12	19 7	19 1	18 14	19 13	19 8	19 7	19 10	19 1	19 0	19 8	19 0	18 14	19 11	18 14	18 14	19 10	18 14	18 12
Average loss both lots.....	1 3	.....	0 8½	0 10	.....	0 6	0 7	.....	0 7½	0 9	.....	0 7½	0 10	.....	0 12	0 13	.....	0 12	0 15½	

With the cheese which went into storage direct from the hoop the paraffining or weighing was not done at any particular time or stated period after coming from the hoop. The cheese was closely observed and was paraffined when it had commenced to mold. The time, of course, was longer for the cheese placed in the 32-degree room than for that in the 40-degree room. The cheese placed direct from the hoop into the cold rooms did not color up as rapidly as when kept in the factory, hence the paraffining was delayed as long as possible. It was thought that the paraffining might have some undesirable effect in preventing the desired coloration in the fresh cheese. On the other hand it was believed that the delay in paraffining, when the cheese was kept in a cold and almost saturated atmosphere, could not have had any bad effect other than in allowing mold to grow.

As has been stated, the influence of temperature on shrinkage is not so important since the adoption of paraffining as it was in the beginning of cold-curing experiments. The loss of weight under the paraffin is very slight, sometimes the cheese weighing as much five months after going into storage as when first paraffined. The interesting feature of the weight of the cheese in these experiments, as given in Table II, was the effect on the loss of holding the cheese from one to two weeks before paraffining and storing, as was done in the regular line of the experiment.

The table shows that there was an average loss of 1 pound 3 ounces per cheese in the cheese kept in the factory curing room until thoroughly cured. The average loss of the cheese put direct into the cold room from the hoops indicates that there was a greater loss in the 32-degree room than in the 40-degree room both before and after paraffining. As the cheese was held longer in the former room before paraffining, the greater loss during this period might be expected, but no satisfactory explanation can be given of the greater loss after paraffining. With the cheese put into the cold rooms at one and two weeks of age the 32-degree room gave less average shrinkage in both cases. This would be the expected result.

The most interesting feature of the results is the decided saving in weight by putting cheese in storage at one week of age rather than at two weeks of age. This saving amounted to 4 ounces per cheese in the 32-degree room and 5 ounces per cheese in the 40-degree room. This, while seemingly small, is enough of a saving to interest both makers and dealers who handle large lots of cheese. If the weight lost before paraffining could be added, it would be an important item, an amount worth attempting to save if this could be done without injury to the quality of the cheese. At the present time it is considered impossible successfully to paraffin and store a cheese fresh from the press. Some work has been done along this line, but the results need further experimental demonstration. It might be said, however, that it will

probably be found that cheese can be paraffined as it comes from the hoop if it is expected to hold the cheese two months before selling. Otherwise the cheese would not color up as desired, but would remain a pale whitish color, which would undoubtedly injure its market price under present standards.

In considering the great variation in weights of individual cheeses, as shown in Table II, many things are found which are difficult to explain. In many cases there was no loss whatever from the time of paraffining to the time of the last weighing and scoring, these dates being from five to seven months apart. In one or two cases there was a loss of 8 ounces per cheese, and in a number of cases 6 ounces were lost. This is a wide range, and the only explanation is that there was a difference in the paraffining. The paraffin may be applied at a very high temperature, in which case a very thin coating is left on the surface of the cheese. This effects a saving in paraffin, and for various reasons makes a much neater appearance. But it appears that mold will grow through the thin paraffin, and it is probable that the thin coat allows a considerable amount of moisture to escape. This particular point should be determined by experimental tests, as it is a question of considerable importance. The writer hopes to get some further information on this subject, as well as concerning the practicability of paraffining cheese fresh from the press. In present practice the temperature of paraffining tanks is not regulated in any manner. Though nearly all cheese is paraffined, the practice is still in its infancy and little is known about its finer points.

SCORES OF THE CHEESE.

As previously stated, the cheese in these experiments was scored only once, and this scoring was done January 6. The numerical and descriptive scores of the different judges is given in Tables III and IV. The scores of the factory-cured cheese are shown in Table V. Table VI gives the average total scores.

TABLE III.—Detailed numerical and descriptive scores of low-rennet cold-cured cheese.

CHEESE STORED AT 32° F.

Age of cheese when stored.	Judge.	Numerical score.					Descriptive score.			
		Flavor.	Texture.	Color.	Make-up.	Total.	Flavor.	Texture.	Color.	Remarks.
Lot 1.										
Fresh.....	B.	41	28	15	10	94	Tainted.....	Gas holes.....	Straight.....	
	S.	41	26	15	10	92	do.....	do.....	do.....	
	W.	42	26	15	10	93	Flat.....	do.....	Straight.....	
Average.....		41.3	26.7	15	10	93				
One week.....	B.	36	25.5	15	10	86.5	Tainted.....	Gas holes.....	Straight.....	
	S.	39	25	15	10	89	do.....	Gas holes; loose.....	do.....	
	W.	38	25	15	10	88	do.....	Gas holes.....	Straight.....	
Average.....		37.7	25.2	15	10	87.9				
Two weeks.....	B.	36	25	14	10	85	Tainted.....	Gas holes.....	Slightly wavy.....	
	S.	40	25	15	10	90	do.....	do.....	do.....	
	W.	38	23	15	10	86	Flavory.....	Pin holes.....	Straight.....	
Average.....		38	24.3	14.6	10	87				
Lot 2.										
Fresh.....	B.	43.5	29.5	15	10	98	Clean.....	Smooth.....	Straight.....	
	S.	44	28	15	10	97				
	W.	44	28	15	10	97	Clean.....	Close; waxy.....	Straight.....	
Average.....		43.8	28.5	15	10	97.3				
One week.....	B.	42	29	15	10	96		Stiff.....	Straight.....	
	S.	43	28	15	10	96				
	W.	42	28	15	10	95	Flat.....	Close; waxy.....	Straight.....	
Average.....		42.3	28.3	15	10	95.6				
Two weeks.....	B.	43	28	15	10	96		Holes; stiff.....	Straight.....	
	S.	42	28	15	10	95				
	W.	42	27	14	10	93	Flat.....	Holes; stiff.....	Shade wavy.....	
Average.....		42.3	27.7	14.6	10	94.6				
Lot 3.										
Fresh.....	B.	44	29.5	15	10	98.5	Clean.....	Close; wavy.....	White specks.....	
	S.	42	28	15	10	95	Flat.....			

	W.	44	27	15	10	96	Clean.....	Silky; weak.....	Straight.....	Paraffined cold; mold grew under.
Average.....		43.3	28.3	15	10	96.6				
One week.....	B. S. W.	42 41 44	29 28 29	15 15 15	10 10 10	96 94 98		Close; waxy.....	Straight.....	
Average.....		42.3	28.7	15	10	96	Clean.....	Silky.....	Straight.....	
Two weeks.....	B. S. W.	43 43 44	29 28 29	15 15 15	10 10 10	97 96 98	Clean flat..... Flat..... Clean.....	Stiff..... Silky.....	Straight..... Straight.....	
Average.....		43.3	28.7	15	10	97				
Lot 4.										
Fresh.....	B. S. W.	42 41 43	29.5 28 27	15 15 14	10 10 10	96.5 94 94	Flat..... do..... do.....	Slightly weak; waxy..... Loose..... Waxy.....	Straight..... Straight.....	
Average.....		42	28.2	14.6	10	94.8				
One week.....	B. S. W.	42 39 43	29.5 28 28	15 15 14	10 10 10	96.5 92 95	High..... Tainted.....	Smooth; waxy; close..... Waxy.....	White specks..... Straight.....	
Average.....		41.3	28.5	14.6	10	94.4				
Two weeks.....	B. S. W.	43.5 41 43	29.5 28 29	15 15 15	10 10 10	98 94 97	Clean..... Flat..... do.....	Smooth; silky..... Loose..... Close; waxy.....	Straight..... Straight.....	Moldy outside.
Average.....		42.5	28.8	15	10	96.3				
Lot 5.										
Fresh.....	B. S. W.	41.5 42 41	29 28 27	15 15 15	10 10 10	95.5 95 93	Flat..... Flat.....	Smooth; waxy..... Close; weak.....	Straight..... Straight.....	
Average.....		41.5	28	15	10	94.5				
One week.....	B. S. W.	39 40 40	27.5 27 29	15 15 15	10 10 10	91.5 92 94	Off flavor..... Off flavor.....	Stiff; mealy..... Gritty..... Close; waxy.....	Straight..... Straight.....	
Average.....		39.6	27.8	15	10	92.5				

TABLE III.—Detailed numerical and descriptive scores of low-rennet cold-cured cheese—Continued.

CHEESE STORED AT 32° F.—Continued.

Age of cheese when stored.	Judge.	Numerical score.					Descriptive score.			
		Flavor.	Texture.	Color.	Make-up.	Total.	Flavor.	Texture.	Color.	Remarks.
Lot 6.										
Fresh.....	B.	44	29.5	15	10	98.5	Clean.....	Silky; waxy.....	Perfect.....	
	S.	43	28	15	10	96	Flat.....			
	W.	44	28	15	10	97	Clean.....	Silky.....	Straight.....	
Average.....		43.6	28.5	15	10	97.1				
One week.....	B.	43	29.5	15	10	97.5	Clean.....	Smooth; waxy.....	Perfect; straight.....	
	S.	43	28	15	10	96	Flat.....			
	W.	44	29	15	10	98	Clean.....	Waxy.....	Straight.....	
Average.....		43.3	28.8	15	10	97.1				
Two weeks.....	B.	42	27	14	10	93	Clean.....	Holes; loose.....	Slightly wavy.....	
	S.	42	27	14.5	10	93.5	Flat.....			
	W.	42	28	14	10	94	Flat; bitter.....	Waxy.....	Straight.....	
Average.....		42	27.3	14.1	10	93.5				
Lot 7.										
Fresh.....	B.	43.5	29.5	15	10	98	Clean.....	Silky; waxy.....	Straight.....	
	S.	41	27	14	10	92	Flat.....		Faded.....	
	W.	44	29	15	10	98	Clean.....	Waxy.....	Straight.....	
Average.....		42.8	28.5	14.6	10	96				
One week.....	B.	40	29	14.5	10	93.5	Slightly bitter; slight taint.....	Mealy.....	Slightly wavy.....	
	S.	39	26	14	10	89	Too high acid.....	Mealy; gritty.....	Acid cut; faded.....	
	W.	40	28	14	10	92	Flat; acid.....	Gritty; waxy.....	Faded slightly.....	
Average.....		39.6	27.6	14.1	10	91.3				
Two weeks.....	B.	42	27.5	15	10	94.5	Slight taint.....	Gritty.....	Straight.....	
	S.	40	27	14	10	91			Faded.....	
	W.	43	28	14	10	95	Clean.....	Holes; waxy.....	Slightly faded.....	
Average.....		41.6	27.5	14.3	10	93.4				
Lot 8.										
Fresh.....	B.	41	28.5	15	10	94.5	Slight acid.....	Smooth; stiff.....		

	S.	41	26	14	10	91	Too high acid.....	Mealy.....	Acid cut.....
	W.	42	27	12	10	91	Acid; flat.....	Gritty.....	Faded some.....
Average.....		41.3	27.1	13.6	10	92.2			
One week.....	B.	40	27	15	10	92	Not clean.....	Stiff; mealy.....	
	S.	40	26	14	10	90	Too high acid.....	Mealy.....	Faded.....
	W.	39	24	12	13	85	Acid.....	do.....	do.....
Average.....		39.6	25.6	13.6	10	89			
Two weeks.....	B.	40	26	13	10	89	Too high acid.....	Mealy; gritty.....	Acid cut; faded.....
	S.	39	25	15	10	89	do.....	Mealy; stiff.....	Straight.....
	W.	43	25	12	10	90	Acid; flat.....	Mealy; gritty.....	Slightly faded.....
Average.....		40.6	25.3	13.3	10	89.2			
Lot 10.									
Fresh.....	S.	42.5	28	15	10	95.5	Flat.....	Loose.....	
	W.	43	29	15	10	97	Clean.....	Silky.....	Straight.....
Average.....		42.7	28.5	15	10	96.2			
One week.....	S.	42	28	15	10	95	Flat.....		
	W.	43	28	14	10	95	do.....	Waxy.....	Slightly faded.....
Average.....		42.5	28	14.5	10	95			
Two weeks.....	S.	41	26	15	10	92	Flat.....	Holes; loose.....	
	W.	41	28	14	10	93	Flat; shade bitter.....	Waxy.....	Slightly faded.....
Average.....		41	27	14.5	10	92.5			
Lot 11.									
Fresh.....	S.	40	28	14	10	92	Flat.....		
	W.	44	29	13	10	96	Clean.....	Holes; silky.....	Wavy.....
Average.....		42	28.5	13.5	10	94			
One week.....	S.	40	27	15	10	92	Flat.....		
	W.	44	29	14	10	97	Clean.....	Silky.....	Shade wavy.....
Average.....		42	28	14.5	10	94.5			
Two weeks.....	S.	42	28	15	10	95			
	W.	44	29	15	10	98	Clean.....	Holes; waxy.....	Straight.....
Average.....		43	28.5	15	10	96.5			

TABLE III.—Detailed numerical and descriptive scores of low-rennet cold-cured cheese—Continued.

CHEESE STORED AT 32° F.—Continued.

Age of cheese when stored.	Judge.	Numerical score.					Descriptive score.			
		Flavor.	Texture.	Color.	Make-up.	Total.	Flavor.	Texture.	Color.	Remarks.
Lot 12.										
Fresh.....	B.	44	29.5	15	10	98.5	Clean.....	Smooth; waxy.....		
	S.	42	27.5	15	10	94.5	Flat.....			
	W.	44	29	15	10	98	Clean.....	Smooth; waxy.....	Straight.....	
Average.....		43.3	28.6	15	10	96.9				
One week.....	B.	39	28	14	10	91	Bitter; flat.....	Smooth.....	Wavy.....	
	S.	42	27	14	10	93	Flat.....		Faded.....	
	W.	43	28	14	10	95	do.....	Holes; waxy.....	Slightly faded.....	
Average.....		41.3	27.6	14	10	93				
Two weeks.....	B.	43	28.5	15	10	96.5	Clean.....	Smooth.....	Perfect.....	
	S.	41	27	15	10	93			Faded.....	
	W.	43	29	15	10	97	Flat.....	Waxy.....	Faded some.....	
Average.....		42.3	28.1	15	10	95.5				
Lot 13.										
Fresh.....	S.	42.5	27	14.5	10	94	Flat; too high acid.....		Faded.....	
	W.	41	27	12	10	90	Shade acid.....	Mealy.....	Slightly faded.....	
Average.....		41.7	27	13.2	10	92				
One week.....	S.	41	27	14	10	92	Flat; too high acid.....	Mealy.....	Faded.....	
	W.	43	27	14	10	94	Clean.....	Holes; waxy.....	Straight.....	
Average.....		42	27	14	10	93				
Two weeks.....	S.	42	27	14.5	10	93.5	Flat.....		Faded.....	
	W.	41	26	14	10	91	Acid; flat; shade bitter.....	Gritty.....	Straight.....	
Average.....		41.5	26.5	14.2	10	92.2				
Lot 14.										
Fresh.....	S.	43	27	15	10	95	Flat.....	Loose.....		Not paraffined;
	W.	42	28	15	10	95	do.....	Waxy.....	Slightly faded; wavy.....	
Average.....		42.5	27.5	15	10	95				

One week.....	S. W.	42 42	26 28	15 15	10 10	93 95	Flat..... do.....	Loose..... Holes; waxy.....		Soft rind.
Average.....		42	27	15	10	94				
Two weeks.....	S. W.	41 42	26 28	15 15	10 10	92 95	Too high acid..... Flat.....	Loose..... Smooth.....	Faded..... Straight.....	
Average.....		41.5	27	15	10	93.5				
Lot 15.										
Fresh.....	B. S. W.	42 41 43	29 28 28	15 15 15	10 10 10	96 94 96	Off flavor..... Flat..... do.....	Smooth..... Close; waxy.....	Straight..... Straight.....	
Average.....		42	28.3	15	10	95.3				
One week.....	B. S. W.	40 40 42	27 27 28	15 15 15	10 10 10	92 92 95	Tainted; off flavor... Ripe..... Flat.....	Pasty..... Gritty..... Close; waxy.....	Straight..... Straight.....	
Average.....		40.6	27.6	15	10	93				
Two weeks.....	B. S. W.	42 40 42	28.5 27 29	15 15 15	10 10 10	95.5 92 96	Off flavor..... Ripe..... Flat.....	Holes; mealy..... Tallowy..... Close; waxy; smooth..	Straight..... Straight.....	
Average.....		41.3	28.1	15	10	94.4				
Lot 16.										Not paraffined.
Fresh.....	S. W.	42 43	28 28	15 15	10 10	95 96	Flat..... Clean.....	Loose..... Waxy.....	Straight.....	
Average.....		42.5	28	15	10	95.5				
One week.....	S. W.	40 41	27 26	14.5 14	10 10	91.5 91	Flat..... do.....	Loose; mealy..... Holes; gritty.....	Faded..... Straight.....	
Average.....		40.5	26.5	14.2	10	91.2				
Two weeks.....	S. W.	39 40	26 25	14 13	10 10	89 88	Tainted; too high acid Flat.....	Holes; mealy..... Mealy.....	Faded..... White specks; wavy..	
Average.....		39.5	25.5	13.5	10	88.5				

TABLE III.—Detailed numerical and descriptive scores of low-rennet cold-cured cheese—Continued.

CHEESE STORED AT 40° F.

Age of cheese when stored.	Judge.	Numerical score.					Descriptive score.			
		Flavor.	Texture.	Color.	Make-up.	Total.	Flavor.	Texture.	Color.	Remarks.
Lot 1.										
Fresh.....	B.	40	28	15	10	93	Tainted.....	Gas holes.....	Straight.....	Bad rind.
	S.	40	26	15	10	91	do.....	Loose.....	do.....	
	W.	41	24	14	10	83	Low.....	Loose; holes.....	Straight.....	
Average.....		40.3	26	14.6	10	91				
One week.....	B.	35	25	15	10	85	Tainted.....	Tallowy; gas holes.....	Straight.....	
	S.	37	26	15	10	88	do.....	Pasty; gas holes.....	do.....	
	W.	38	22	15	10	85	Off flavor.....	Gas holes; loose.....	Straight.....	
Average.....		36.7	24.3	15	10	86				
Two weeks.....	B.	35	25	15	10	85	Tainted.....	Gas holes.....	Straight.....	
	S.	36	26	15	10	87	Overripe; tainted.....	Gas holes; loose.....	do.....	
	W.	37	24	15	10	86	Off flavor; wheyshows.....	do.....	Straight.....	
Average.....		36	25	15	10	86				
Lot 2.										
Fresh.....	B.	43.5	29	15	10	97.5		Smooth.....	Straight.....	
	S.	43	28	15	10	96				
	W.	43	28	15	10	96	Clean.....	Close; waxy.....	Straight.....	
Average.....		43.2	28.6	15	10	98.5				
One week.....	B.	41	28	15	10	94	Slightly tainted.....	Stiff.....	Straight.....	
	S.	40	27	15	10	92		Gritty.....	do.....	
	W.	42	28	15	10	94	Flat.....	Close; waxy.....	Straight.....	
Average.....		41	27.7	15	10	93.7				
Two weeks.....	B.	42	28	15	10	95	Flat.....	Stiff.....	Straight.....	
	S.	42	27	15	10	94		do.....	do.....	
	W.	43	28	14	10	95	Clean.....	Holes; waxy.....	Wavy.....	
Average.....		42.3	27.7	14.6	10	94.6				
Lot 3.										
Fresh.....	B.	44	29.5	15	10	98.5	Clean.....	Smooth; silky.....	Straight.....	Bad rind.
	S.	42.5	28	15	10	95.5	Flat.....			

	W.	44	29	15	10	98	Clean.....	Silky.....	Straight.....	Paraffined cold; mold under rind.
Average.....		43.5	28.8	15	10	97.3				
One week.....	B. S. W.	41 39 43	29 27 29	15 15 13	10 10 10	95 91 95	Flat..... Tainted..... Flat.....	Smooth..... Loose..... Waxy.....	White specks..... White specks.....	
Average.....		41	28.3	14.3	10	93.6				
Two weeks.....	B. S. W.	44 42 44	29 27 29	15 15 15	10 10 10	98 94 98	Clean; high..... Clean.....	Smooth..... Loose..... Waxy.....	Straight..... Straight.....	
Average.....		43.3	28.3	15	10	96.6				
Lot 4.										
Fresh.....	B.	43	30	15	10	98	Flat.....	Smooth; silky; waxy.....	Straight.....	Paraffined cold; mold grew under paraffin very bad,
	S. W.	40 43	28 28	15 15	10 10	93 96	do..... .....do.....	Silky.....	Straight.....	
Average.....		42	28.6	15	10	95.6				
One week.....	B. S. W.	42.5 38 42	29 26 28	15 15 15	10 10 10	96.5 89 95	Not clean; slight taint Tainted..... Flat.....	Waxy..... Loose..... Waxy.....	White specks..... Straight.....	
Average.....		40.8	27.7	15	10	93.5				
Two weeks.....	B. S. W.	42 37 42	28.5 25 27	15 15 15	10 10 10	95.5 87 94	Flat..... Tainted..... Flat.....	Mechanical holes..... Loose; gritty..... Loose holes; waxy.....	Straight.....	Moldy. Do.
Average.....		40.3	26.8	15	10	92.1				
Lot 5.										
Fresh.....	B. S. W.	39 40 39	28 27 28	15 15 15	10 10 10	92 92 92	Off flavor; tainted..... Not clean..... Off flavor.....	Smooth; close..... Gritty..... Close; waxy.....	Straight..... Straight.....	
Average.....		39.3	27.6	15	10	92				
One week.....	B. S. W.	39 39 40	28.5 27 28.5	15 15 15	10 10 10	92.5 91 93.5	Not clean..... Tainted..... Flat.....	Close; stiff..... Gritty..... Close; waxy.....	Straight..... Straight.....	
Average.....		39.3	28	15	10	92.3				

TABLE III.—Detailed numerical and descriptive scores of low-rennet cold-cured cheese—Continued.

CHEESE STORED AT 40° F.—Continued.

Age of cheese when stored.	Judge.	Numerical score.					Descriptive score.				
		Flavor.	Texture.	Color.	Make-up.	Total.	Flavor.	Texture.	Color.	Remarks.	
Lot 5—Continued.											
Two weeks.....	B.	39	27	14.5	10	90.5	Tainted.....	Loose; holes; stiff.....	Slightly wavy.....	Badly paraffined.	
	S.	40	27	15	10	92	Tainted; ripe.....	Gritty.....	Faded.....		
	W.	41	27	14	10	92	Bitter.....	Holes; waxy.....	Straight.....		
Average.....		40	27	14.5	10	91.5					
Lot 6.											
Fresh.....	B.	44	29.5	15	10	98.5	Clean.....	Smooth; silky; waxy.....	Straight.....		
	S.	42	27	14	10	93	Flat.....	Loose.....	Faded.....		
	W.	43	28	14	10	95	do.....	Waxy.....	Slightly faded.....		
Average.....		43	28.1	14.3	10	95.5					
One week.....	B.	44	28	15	10	97	Slightly sharp; high..	Holes; loose.....	Straight.....		
	S.	41	27	14.5	10	92.5	Too ripe.....	Loose.....	Faded.....		
	W.	43	28	12	10	93	Ripe.....	Holes; waxy.....	Straight.....		
Average.....		42.6	27.6	13.8	10	94.1					
Two weeks.....	B.	42	28	15	10	95	Clean; flat.....	Loose; holes; mealy.....	Straight.....		
	S.	42	26	14	10	92	Ripe.....	Mealy.....	Faded.....		
	W.	42	27	14	10	93	Flat.....	Loose; mealy.....	Straight.....		
Average.....		42	27	14.3	10	93.3					
Lot 7.											
Fresh.....	B.	40	29.5	15	10	94.5	Flat.....	Smooth; waxy.....			
	S.	40	27	14	10	91	do.....	Mealy.....	Faded.....		
	W.	40	26	13	10	89	Off flavor.....	Silky; weak.....	Slightly faded.....		
Average.....		40	27.5	14	10	91.5					
One week.....	B.	38	25	14	10	87	Bitter; too high acid..	Mealy; gritty.....	Acid cut.....		
	S.	40	25	14	10	89	do.....	do.....	Too light; faded.....		
	W.	40	26	12	10	88	Acid.....	do.....	Faded.....		
Average.....		39.3	25.3	13.3	10	88					
Two weeks.....	B.	38	26	12	10	86	Slightly acidy.....	Holes; mealy.....	Mottled; acid cut.....		
	S.	38	25	13	10	86	Too high acid.....	Gritty; mealy.....	Too light; acid cut.....		

	W.	38	26	10	10	84	Acid; flavory.....	Mealy.....	Mottled; acid cut.....	
Average.....		38	25.6	11.6	10	85.2				
Lot 8.										
Fresh.....	B.	39	26	14	10	89	Too high acid.....	Tallowy; gritty.....	Faded.....	
	S.	40	26	14	10	90	do.....	Mealy.....	do.....	
	W.	41	26	13	10	90	Flat.....	do.....	Slightly faded.....	
Average.....		40	26	13.6	10	89.6				
One week.....	B.	30	24	10	10	74	High acid; sour.....	Mealy; gritty; close.....	Acid cut.....	
	S.	38	25	13	10	86	do.....	Mealy; gritty.....	Faded.....	
	W.	38	23	10	10	81	Acid.....	Gritty.....	do.....	
Average.....		35.3	24	11	10	80.3				
Two weeks.....	B.	30	20	9	10	69	Tainted; too high acid.....	Tallowy; gritty; holes; loose.....	Mottled.....	
	S.	39	24	12	10	85	Too high acid.....	Mealy; gritty.....	Mottled; faded.....	
	W.	35	22	8	10	75	High acid.....	Tallowy.....	Mottled.....	
Average.....		34.6	22	9.6	10	76.2				
Lot 10.										
Fresh.....	S.	40	27	14.5	10	91.5	Off flavor.....	Loose; weak.....	Faded.....	Damaged under par-
	W.	43	28	11	10	92	Flat.....	Waxy.....	Faded some.....	
Average.....		41.5	27.5	12.7	10	91.7				
One week.....	S.	41	27	14.5	10	92.5	Flat.....	Mealy.....		Moldy.
	W.	42	26	11	10	89	Low.....	Gritty.....	Streaked.....	
Average.....		41.5	26.5	12.6	10	90.6				
Two weeks.....	S.	40	27	14	10	91	Flat; bitter; too high acid.....	Gritty.....	Faded.....	
	W.	40	25	11	10	86	Low.....	do.....	Faded (not bright)...	
Average.....		40	26	12.5	10	88.5				
Lot 11.										
Fresh.....	S.	41	27	15	10	93	Flat.....	Holes.....		
	W.	44	30	15	9	98	Clean.....	Silky.....	Straight.....	
Average.....		42.5	28.5	15	9.5	95.5				
One week.....	S.	40	27	15	10	92	Too high acid.....			
	W.	44	28	15	10	97	Perfect.....	Holes; silky.....	Straight.....	
Average.....		42	27.5	15	10	94.5				

TABLE III.—Detailed numerical and descriptive scores of low-rennet cold-cured cheese—Continued.

CHEESE STORED AT 40° F.—Continued.

Age of cheese when stored.	Judge.	Numerical score.					Descriptive score.			
		Flavor.	Texture.	Color.	Make-up.	Total.	Flavor.	Texture.	Color.	Remarks.
Lot 11—Continued.										
Two weeks.....	S. W.	42 40	26 28	15 15	10 10	93 93	Too high acid..... Flat.....	 Waxy.....	Waxy..... do.....	
Average.....		41	27	15	10	93				
Lot 12.										
Fresh.....	S. W.	43 43	28 28	15 14	10 10	96 95	Flat..... Low.....	 Waxy.....	 Faded some.....	
Average.....		43	28	14.5	10	95.5				
One week.....	B. S. W.	41 40 41	29 26 28	15 14 14	10 10 10	95 90 93	Off flavor..... Off flavor; ripe..... Off flavor.....	Loose..... Loose; mealy..... Waxy.....	 Faded..... do.....	
Average.....		40.6	27.6	14.3	10	92.6				
Two weeks.....	B. S. W.	40 41 42	27 26 28	15 14 14	10 10 10	92 91 94	Sharp..... Ripe; clean..... Ripe.....	Salvy..... Loose..... Holes; waxy.....	 Faded..... Faded at holes.....	
Average.....		41	27	14.3	10	92.3				
Lot 13.										
Fresh.....	S. W.	41 41	26 28	14 14	10 10	91 93	Flat; too high acid ... Flat.....	Mealy..... Waxy.....	Faded..... Straight.....	
Average.....		41	27	14	10	92				
One week.....	S. W.	40 42	26 27	14 14	10 10	90 93	Flat; too high acid ... Flat.....	Mealy..... Holes; waxy.....	Faded..... Straight.....	
Average.....		41	26.5	14	10	91.5				
Two weeks.....	S. W.	40 41	26 26	14 14	10 10	90 91	Flat; too high acid ... Bitter; flat.....	Mealy..... Gritty.....	Faded..... Straight.....	
Average.....		40.5	26	14	10	90.5				
Lot 14.										
Fresh.....	S.	43	27	15	10	95	Flat.....	Loose.....	.....	Soft rind; mold under paraffin.

	W.	44	28	15	10	97	High.....	Waxy.....	Straight.....
Average.....		43.5	27.5	15	10	96			
One week.....	S.	41	27	15	10	93	Bitter.....		
	W.	40	28	15	10	93	Low.....	Waxy.....	Straight.....
Average.....		40.5	27.5	15	10	93			
Two weeks.....	S.	40	26	15	10	91	Too ripe.....	Mealy.....	
	W.	41	26	14	10	91	Low.....	do.....	Slightly faded.....
Average.....		40.5	26	14.5	10	91			
Lot 15.									
Fresh.....	B.	38	28	15	10	91	Off flavor; tainted.....	Smooth.....	Straight.....
	S.	41	27	15	10	93	Flat.....	Loose.....	
	W.	41	29	15	10	95	do.....	Close; waxy.....	Straight.....
Average.....		40	28	15	10	93			
One week.....	B.	36	26	15	10	87	Off flavor; tainted.....	Tallowy; gritty.....	Straight.....
	S.	38	26	15	10	89	Overripe.....	Gritty.....	
	W.	40	28	15	10	93	Flavory.....	Close; waxy.....	Straight.....
Average.....		38	26.6	15	10	89.6			
Two weeks.....	B.	39	26	15	10	90	Off flavor.....	Tallowy; gritty.....	Straight.....
	S.	40	26	15	10	91	Ripe.....	Mealy; gritty.....	
	W.	38	25	15	10	88	Off flavor.....	Close; tallowy.....	Straight.....
Average.....		39	25.6	15	10	89.6			
Lot 16.									
Fresh.....	S.	39	27	14	10	90	Tainted.....		Faded.....
	W.	40	25	15	10	90	Flat.....	Weak.....	Straight.....
Average.....		39.5	26	14.5	10	90			
One week.....	S.	40	26	14	10	90	Tainted.....	Mealy.....	Faded.....
	W.	40	25	14	10	89	Flat.....	do.....	Slightly faded.....
Average.....		40	25.5	14	10	89.5			
Two weeks.....	S.	38	27	14	10	89	Tainted.....		Faded.....
	W.	40	25	14	10	89	Flat.....	Mealy.....	Slightly faded.....
Average.....		39	26	14	10	89			

NOTE.—Lot 1 stored at 32° and lot 1 stored at 40° F. came from the same vat, and the same is true of all other lots with the same numeral. This is also true with regard to the table of high-rennet cheese.

TABLE IV.—Detailed numerical and descriptive scores of high-rennet cold-cured cheese.

CHEESE STORED AT 32° F.

Age of cheese when stored.	Judge.	Numerical score.					Descriptive score.			
		Flavor.	Texture.	Color.	Make-up.	Total.	Flavor.	Texture.	Color.	Remarks.
Lot 1.										
Fresh.....	B.	42	29	15	10	96	Flat.....	Smooth; waxy; holes; loose.	Straight.....	
	S.	42	28	15	10	95	Flat; bitter.....			
	W.	44	28	14	10	96	Clean.....	Silky.....	Streaked; faded some	
Average.....		42.3	28.3	14.6	10	95.3				
One week.....	B.	39	28.5	15	10	92.5	Tainted.....	Smooth; loose.....	Straight.....	
	S.	40	25	15	10	90	Ripe.....	Swiss holes; loose.....		
	W.	40	28	14	10	92	Off flavor.....	Swiss holes; waxy.....	Streaked.....	
Average.....		39.6	27.1	14.6	10	91.5				
Two weeks.....	B.	39	29	15	10	93	Bitter; tainted.....	Holes; stiff.....	Straight.....	
	S.	41	26	15	10	92		Swiss holes; loose.....		
	W.	43	28	15	10	96	Flat.....	Gas holes; waxy.....	Straight.....	
Average.....		41	27.6	15	10	93.6				
Lot 2.										
Fresh.....	B.	43.5	29.5	15	10	98	Flat.....	Smooth; silky.....	Straight.....	
	S.	42	28	15	10	95	do.....			
	W.	43	28	15	10	96	do.....	Close; waxy.....	Straight.....	
Average.....		42.8	28.5	15	10	96.3				
One week.....	B.	42	29	15	10	96	Slight taint.....	Gritty; holes; stiff.....	Straight.....	
	S.	41	27	15	10	93	Ripe.....	Weak.....		
	W.	43	28	15	10	96	Flat.....	Close; waxy.....	Straight.....	
Average.....		42	28	15	10	95				
Two weeks.....	B.	41	28.5	15	10	94.5	Slightly tainted.....	Mealy; loose.....	Straight.....	
	S.	40	26	15	10	91	Ripe; bitter.....	Loose; weak.....		
	W.	43	28	15	10	96	Flat.....	Loose; holes.....	Straight.....	
Average.....		41.3	27.5	15	10	93.8				
Lot 3.										
Fresh.....	B.	42	29	14	10	95	Bitter.....	Loose; waxy.....	Faded.....	
	S.	41	27	15	10	93	Flat.....			Bad rind.

	W.	42	28	14	10	94	Flat; bitter.....	Waxy.....	Faded some.....
Average.....		41.6	28	14.3	10	94			
One week.....	B.	40	29	15	10	94	Slight taint.....	Gritty.....	Straight.....
	S.	39	27	15	10	91	Tainted.....	Loose.....	
	W.	42	28	14	10	94	Flat.....	Waxy.....	Too light.....
Average.....		40.3	28	14.6	10	93			
Two weeks.....	B.	39	28	14.5	10	91.5	Tainted; bitter.....	Mealy.....	Faded.....
	S.	37	26	14	10	87	do.....	do.....	do.....
	W.	42	27	13	10	92	Some bitter.....	Loose; waxy.....	Faded some.....
Average.....		39.3	27	13.8	10	90.1			
Lot 5.									
Fresh.....	B.	43	29	15	10	97	Clean; flat.....	Smooth; weak.....	Straight.....
	S.	42	28	15	10	95			
	W.	43	29	15	10	97	Clean.....	Close; waxy.....	Straight.....
Average.....		42.6	28.6	15	10	96.3			
One week.....	B.	41.5	29	15	10	95.5	Tainted; not clean...	Smooth; waxy.....	Straight.....
	S.	41	27.5	15	10	93.5	Not clean; flat.....	Loose.....	
	W.	42	28	15	10	95	Clean.....	Smooth; close.....	Straight.....
Average.....		41.5	28.1	15	10	94.6			
Two weeks.....	B.	41	28	15	10	94	Tainted; not clean...	Mechanical holes; smooth; waxy.....	White specks.....
	S.	40	27	15	10	92	Not clean.....	Loose.....	
	W.	42	27	15	10	94	Flat.....	Loose; holes; waxy.....	Straight.....
Average.....		41	27.3	15	10	93.3			
Lot 6.									
Fresh.....	B.	39.5	27.5	11	10	88	Tainted; bitter.....	Tallowy; pasty.....	Mottled.....
	S.	40	25	15	10	90	Very bitter.....	Loose.....	do.....
	W.	41	27	8	10	86	Shade bitter.....	Loose; pasty.....	do.....
Average.....		40.1	26.5	11.3	10	88			
Two weeks.....	B.	38	26	11	10	85	Tainted; bitter.....	Tallowy; pasty; loose.....	Mottled.....
	S.	39	26	12	10	87	do.....	Weak.....	do.....
	W.	39	25	8	10	82	Flavory; bitter.....	Pasty; loose.....	do.....
Average.....		38.6	25.6	10.3	10	84.5			

TABLE IV.—Detailed numerical and descriptive scores of high-rennet cold-cured cheese—Continued.

CHEESE STORED AT 32° F.—Continued.

Age of cheese when stored.	Judge.	Numerical score.					Descriptive score.			
		Flavor.	Texture.	Color.	Make-up.	Total.	Flavor.	Texture.	Color.	Remarks.
Lot 7.										
Fresh.....	B.	43.5	30	15	10	98.5	Clean; high.....	Smooth; waxy.....	Straight.....	
	S.	42	28.5	15	10	95.5	Flat; bitter.....			
	W.	44	28	14	10	96	Clean.....	Close; waxy.....	Straight.....	
Average.....		43.1	28.8	14.6	10	96.6				
One week.....	B.	42	29.5	15	10	96.5	Flat.....	Smooth; waxy.....	Straight.....	
	S.	41	27	15	10	93	do.....	Loose.....		
	W.	42	28	14	10	94	Flat; ripe.....	Holes; silky; close; smooth..	Straight.....	
Average.....		41.6	28.1	14.6	10	94.5				
Two weeks.....	B.	42	29.5	15	10	96.5	Slight taint.....	Smooth; loose; waxy.....	Straight.....	
	S.	41	27	15	10	93		Loose.....		
	W.	42	29	14	10	95	Flat.....	Holes; close; smooth; silky..	Straight.....	
Average.....		41.6	28.5	14.6	10	94.8				
Lot 8.										
Fresh.....	B.	44	29.5	15	10	98.5	Clean; high.....	Smooth; silky; waxy.....	Straight.....	
	S.	43.5	28.5	15	10	97		Loose.....		
	W.	44	29	15	10	98	Clean; ripe.....	Close; silky.....	Straight.....	
Average.....		43.8	29	15	10	97.8				
One week.....	B.	43.5	29.5	15	10	98	Clean; high.....	Smooth; silky; waxy.....	Straight; white specks	
	S.	42	27.5	14	10	93.5	Flat.....	Loose.....	White specks.....	
	W.	43	28	12	10	93	Clean.....	Close; waxy.....	White specks; faded..	
Average.....		42.8	28.3	13.6	10	94.8				
Two weeks.....	B.	43.5	29.5	15	10	98	Clean; high.....	Smooth; silky.....	Straight.....	
	S.	43	28	15	10	96				
	W.	43	29	15	10	97	Clean.....	Close; waxy.....	Straight.....	
Average.....		43.1	28.8	15	10	97				
Lot 9.										
Fresh.....	B.	41	28.5	14	10	93.5	Flat; bitter.....	Loose; waxy; silky.....		
	S.	41	27	14	10	92	Flat.....	Weak.....	Faded.....	

	W.	43	28	13	10	94	Flat; ripe.....	Waxy.....	Slightly faded.....
Average.....		41.6	27.8	13.6	10	93.2			
One week.....	B.	40	29	14.5	10	93.5	Tainted.....	Loose.....	Straight.....
	S.	38	26	13	10	87	do.....	Mealy.....	Too light; faded.....
	W.	40	28	10	10	88	Bitter.....	Waxy.....	Faded.....
Average.....		39.3	27.6	12.5	10	89.4			
Two weeks.....	B.	36	28	15	10	89	Tainted.....	Pasty; watery.....	
	S.	36	24	13	10	83	Tainted; bitter; too high acid.	Mealy.....	Mottled; faded; acid cut; too light.
	W.	40	28	13	10	91	Acid; bitter.....	Waxy.....	Slightly faded.....
Average.....		37.3	26.6	13.6	10	87.6			
Lot 10.									
Fresh.....	B.	39	26.5	15	10	90.5	Tainted.....	Pasty; weak.....	Straight.....
	S.	41	26	15	10	92	do.....	do.....	
	W.	43	25	15	10	93	Clean.....	Ripe; close; waxy.....	Straight.....
Average.....		41	25.8	15	10	91.8			
Two weeks.....	B.	38	29	15	10	92	Tainted.....	Smooth; close; waxy.....	Straight.....
	S.	40	27	15	10	92	Ripe.....	Weak.....	
	W.	39	28	15	10	92	Off flavor.....	Close; waxy.....	Too light.....
Average.....		39	28	15	10	92			
Lot 11.									
Fresh.....	B.	43.5	30	15	10	98.5	Not clean.....	Smooth; silky.....	Straight.....
	S.	40	27	14	10	91	Flat.....		
	W.	42	26	14	10	92	do.....	Smooth; close; meaty.....	Straight.....
Average.....		41.8	27.6	14.3	10	93.8			
One week.....	B.	43.5	29.5	15	10	98		Smooth; silky.....	Straight.....
	S.	40.5	27	14.5	10	92			
	W.	42	27	14	10	93	Flat.....	Close; ripe; silky.....	Straight.....
Average.....		42	27.8	14.5	10	94.3			
Two weeks.....	B.	41	29.5	15	10	95.5	Tainted; whey flavor.	Smooth; waxy.....	Perfect.....
	S.	36	30	15	10	91	Tainted; ripe.....	Weak.....	Faded.....
	W.	40	26	14	10	90	Off flavor.....	Close; ripe; smooth.....	Straight.....
Average.....		39	28.5	14.6	10	92.2			

Not paraffined.

TABLE IV.—Detailed numerical and descriptive scores of high-rennet cold-cured cheese—Continued.

CHEESE STORED AT 32° F.—Continued.

Age of cheese when stored.	Judge.	Numerical score.					Descriptive score.			
		Flavor.	Texture.	Color.	Make-up.	Total.	Flavor.	Texture.	Color.	Remarks.
Lot 12.										
Fresh.....	B.	43	30	15	10	98	Not quite clean.....	Perfect; smooth; silky.....	Perfect.....	Not paraffined.
	S.	40	28	15	10	93	Flat.....	Weak.....		
	W.	44	28	15	10	97	Clean.....	Close; meaty; silky.....	Straight.....	
Average.....		42.3	28.6	15	10	96				
One week.....	B.	42	29.5	15	10	96.5	Slightly bitter.....	Smooth; waxy.....	Perfect.....	
	S.	39	27	15	10	91	Tainted.....	Weak.....		
	W.	42	28	15	10	95	Off flavor; flat.....	Close; meaty; silky.....	Straight.....	
Average.....		41	28.3	15	10	94.3				
Two weeks.....	B.	39	28	15	10	92	Off flavor; tainted...	Pasty; weak.....	Straight.....	
	S.	36	25	14	10	85	Tainted.....	Weak.....	Faded.....	
	W.	40	26	14	10	90	Off flavor; overripe..	Close; waxy.....	Straight.....	
Average.....		38.3	26.3	14.3	10	89				

CHEESE STORED AT 40° F.

Lot 1.										
Fresh.....	B.	42	29	15	10	96	Flat; clean.....	Smooth.....	Straight.....	Thick paraffin.
	S.	41	27	15	10	93	Flat.....	Loose.....		
	W.	44	28	15	10	97	Clean.....	Waxy.....	Straight.....	Cold paraffin; bad rind.
Average.....		42.3	28	15	10	95.3				
One week.....	B.	40	28	14	10	92	Not clean.....	Loose; gritty.....	Wavy.....	
	S.	41	28	15	10	94	Flat; bitter.....			
	W.	42	28	14	10	94	do.....	Holes; waxy.....	White specks.....	
Average.....		41	28	14.3	10	93.3				
Two weeks.....	B.	43	28	15	10	96	Flat.....	Gritty; holes; loose.....	Straight.....	
	S.	40	25	15	10	90	Flat; bitter.....	Loose.....		
	W.	43	27	15	10	95	Flat.....	Large mechanical holes; waxy.	Straight.....	
Average.....		42	26.6	15	10	93.6				

TABLE IV.—Detailed numerical and descriptive scores of high-rennet cold-cured cheese—Continued.

CHEESE STORED AT 40° F.—Continued.

Age of cheese when stored.	Judge.	Numerical score.					Descriptive score.			
		Flavor.	Texture.	Color.	Make-up.	Total.	Flavor.	Texture.	Color.	Remarks.
Lot 5—Continued.										
Two weeks.....	B.	41	28	15	10	94	Slight taint; not clean	Mealy; loose.....	Straight.....	
	S.	41	26	15	10	92	do.....	Loose.....	do.....	
	W.	41	27	15	10	93	Off flavor.....	Loose; waxy.....	Straight.....	
Average.....		41	27	15	10	93				
Lot 6.										
Fresh.....	B.	36	26	10	10	82	Tainted.....	Pasty; weak.....	Mottled.....	
	S.	36	26	10	10	82	do.....	Weak.....	Mottled; faded.....	
	W.	39	24	7	10	80	Flavory.....	Pasty.....	Mottled.....	
Average.....		27	25.3	9	10	81.3				
One week.....	B.	36	26	10	10	82	Tainted; bitter.....	Pasty; tallowy.....	Mottled.....	
	S.	37	25	12	10	84	do.....	Weak.....	do.....	
	W.	40	24	8	10	82	Flavory.....	Pasty; tallowy.....	do.....	
Average.....		37.6	25	10	10	82.6				
Two weeks.....	B.	38	26	11	10	85	Tainted; bitter.....	Pasty; tallowy.....	Mottled.....	
	S.	38	25	11	10	84	do.....	Weak.....	Mottled; faded.....	
	W.	40	26	8	10	84	Bitter.....	Pasty; tallowy.....	Mottled.....	
Average.....		38.6	25.6	10	10	84.2				
Lot 7.										
Fresh.....	B.	42	29.5	15	10	96.5	Starter.....	Smooth; silky; waxy.....	Straight.....	
	S.	41	28	15	10	94	Flat.....	do.....	do.....	
	W.	42	29	15	10	96	do.....	Silky; close.....	Straight.....	
Average.....		41.6	28.8	15	10	95.5				
One week.....	B.	43.5	29.5	15	10	98	Clean; high.....	Smooth; stiff.....	Straight.....	
	S.	42	28	15	10	95	Flat.....	do.....	do.....	
	W.	43	29	15	10	97	do.....	Close; waxy.....	Straight.....	
Average.....		42.8	28.8	15	10	96.6				
Two weeks.....	B.	39	29	15	10	93	Tainted.....	Stiff; loose.....	Straight.....	
	S.	42	28	15	10	95	Ripe.....	do.....	do.....	

	W.	42	29	15	10	96	Flat.....	Close; silky.....	Straight.....
Average.....		41	28.6	15	10	94.6			
Lot 8.									
Fresh.....	B.	44	29.5	15	10	98.5	Clean.....	Smooth; waxy.....	Straight.....
	S.	43	28.5	15	10	96.5			
	W.	43	29	15	10	97	Clean; ripe.....	Close; silky.....	Straight.....
Average.....		43.3	29	15	10	97.3			
One week.....	B.	43.5	29.5	14.5	10	97.5	High.....	Loose.....	Slightly wavy.....
	S.	42	27	15	10	94	do.....	do.....	
	W.	43	27	14	10	94	Flat.....	Waxy.....	Faded some.....
Average.....		42.8	27.8	14.5	10	95.2			
Two weeks.....	B.	42	29.5	15	10	96.5	Clean.....	Smooth; waxy.....	Straight.....
	S.	41	27	15	10	93	Ripe; bitter.....	Loose.....	
	W.	43	28	15	10	96	Ripe; clean.....	Close; waxy.....	Straight.....
Average.....		42	28.3	15	10	95.3			
Lot 9.									
Fresh.....	B.	40	27	14	10	91	Flat.....	Pasty; loose.....	Slightly wavy.....
	S.	40	26	13	10	89	do.....	Mealy.....	Too light.....
	W.	42	27	13	10	92	do.....	Waxy.....	do.....
Average.....		40.6	26.6	13.3	10	90.6			
One week.....	B.	37	28	14	10	89	Too high acid; bitter..	Tallowy.....	Slightly wavy.....
	S.	39	25	13	10	87	do.....	Mealy.....	Too light; faded.....
	W.	41	27	13	10	91	Bitter.....	Mealy; tallowy.....	Too light.....
Average.....		39	26.6	13.3	10	89			
Two weeks.....	B.	37	24	12	10	83	Tainted.....	Gritty; loose.....	Wavy.....
	S.	39	25	13	10	87	Too high acid; bitter..	Gritty; mealy.....	Too light; faded.....
	W.	42	27	13	10	91	Flat.....	Gritty.....	Too light.....
Average.....		39.3	25.3	12.6	10	87.2			
Lot 10.									
Fresh.....	B.	42	29	15	10	96	Not quite clean.....	Pasty.....	Straight.....
	S.	39	26	14	10	89	Ripe.....	Weak.....	Faded.....
	W.	44	29	15	10	98	Clean.....	Close; silky.....	Straight.....
Average.....		41.6	28	14.6	10	94.3			

TABLE IV.—Detailed numerical and descriptive scores of high-rennet cold-cured cheese—Continued.

CHEESE STORED AT 40° F.—Continued.

Age of cheese when stored.	Judge.	Numerical score.					Descriptive score.			
		Flavor.	Texture.	Color.	Make-up.	Total.	Flavor.	Texture.	Color.	Remarks.
Lot 10—Continued.										
One week.....	B. S. W.	37 39 42	26 26 27	15 14 14	10 10 10	88 89 93	Off flavor; tainted.... Tainted; tainted..... Flat.....	Tallowy; holes; pasty..... Pasty; weak..... Pasty; loose.....	Straight..... Faded..... Straight.....	
Average.....		39.3	26.3	14.3	10	90				
Two weeks.....	B. S. W.	37 40 42	25 25 26	14 15 14	10 10 10	86 90 92	Off flavor; tainted.... Tainted; ripe..... Flat.....	Tallowy; holes; pasty..... Weak; pasty..... Loose; pasty.....	Wavy..... Faded..... Straight.....	
Average.....		39.6	25.3	14.3	10	89.3				
Lot 11.										
Fresh.....	B. S. W.	40 40 41	29 27 28	15 14 14	10 10 10	94 91 93	Tainted; old milk..... Tainted; bitter..... Bitter.....	Smooth; waxy..... Weak..... Close; ripe; silky.....	Straight..... Faded..... Straight.....	Rind poor.
Average.....		40.3	28	14.3	10	92.6				
One week.....	B. S. W.	40.5 36 40	29.5 25 27	15 14 14	10 10 10	95 85 91	Whey flavor; old milk. Tainted; bitter..... Off flavor.....	Smooth; waxy..... Weak..... Close; ripe; smooth.....	Straight..... Faded..... Straight.....	
Average.....		38.8	27.2	14.3	10	90.3				
Two weeks.....	B. S. W.	38 39 40	27 29 27	14 15 14	10 10 10	89 93 91	Tainted..... do..... Off flavor.....	Gritty; weak..... Holes; mealy..... Close; smooth.....	Faded..... White specks..... Straight.....	
Average.....		39	27.6	14.3	10	91				
Lot 12.										
Fresh.....	B. S. W.	38 38 40	29.5 26 28	15 15 15	10 10 10	92.5 89 93	Tainted; bitter..... do..... Tainted.....	Smooth; silky..... Loose..... Loose; waxy.....	Straight..... Faded..... Straight.....	
Average.....		38.6	27.8	15	10	91.5				

One week.....	B.	38	29.5	15	10	92.5	Tainted; bitter.....	Waxy.....	Straight.....
	S.	38	26	15	10	89	Tainted.....	Weak.....	Faded.....
	W.	40	27	15	10	92	Off flavor.....	Close; silky.....	Straight.....
Average.....		38.6	27.5	15	10	91.1			
Two weeks.....	B.	37	28	15	10	90	Too high acid; tainted; bitter.	Pasty.....	Straight.....
	S.	37	26	15	10	88	Tainted.....	Weak.....	Faded.....
	W.	39	28	15	10	92	Off flavor.....	Close; silky.....	Straight.....
Average.....		37.6	27.3	15	10	90			

TABLE V.—*Scores of cheese cured in factory.*

LOW RENNET.

Lot.	Flavor.	Texture.	Color.	Make-up.	Total.	Flavor of cheese.	Texture.
1...	34	23	15	10	82	Sweet, heated.....	Gritty; Swiss holes.
2...	34	20	15	10	79	Tainted.....	Stiff; mealy; loose.
3...	34	20	15	10	79	do.....	Do.
4...	33½	21½	15	10	80	Old milk.....	Gritty; mechanical holes.
5...	35½	21	15	10	81½	Tainted.....	Stiff; mealy.
6...	22	22	15	10	69	Tainted, dirty.....	Gritty; loose.
7...	26	20	15	10	71	Acid, tainted.....	Tallowy; loose.
8...	34	22	15	10	81	Acid.....	Mealy.
10...	29	27	15	10	81	Tainted, bitter.....	Smooth; close.
11...	37	26	15	10	88	Tainted.....	Salvy; gritty.
12...	42	24½	15	10	91½	Clean.....	Gritty; loose.
13...	38	24½	15	10	87½	Heated.....	Salvy; close.
14...	35	23	15	10	83	Weedy.....	Do.
15...	38	24	15	10	87	.....	Mealy; dry.
16...	34	21	15	10	80	Weedy.....	Dry; mealy.

HIGH RENNET.

1...	37	24	15	10	86	Tainted.....	Salvy; gritty; loose.
2...	40½	28	15	10	93½	Heated.....	Stiff; close.
3...	33	24	15	10	82	Tainted.....	Pasty; loose.
5...	42½	29	15	10	96½	Clean.....	Waxy; close.
6...	40½	27½	15	10	93	.....	Dry; mechanical holes.
7...	42½	27½	15	10	95	.....	Smooth; mechanical holes.
8...	41	28	15	10	94	Slightly bitter.....	Waxy.
9...	30	22	15	10	77	Acid, bitter.....	Tallowy.
10...	42½	27	15	10	94½	Clean.....	Mechanical holes.
11...	38	24½	15	10	87½	Bitter.....	Loose.
12...	43	29	15	10	97	Clean.....	Close.

TABLE VI.—*Average total scores of cheese by lots.*

LOW RENNET.

Lot.	In 32-degree room from hoops.	In 40-degree room from hoops.	In 32-degree room at one week.	In 40-degree room at one week.	In 32-degree room at two weeks.	In 40-degree room at two weeks.	Cured at factory.
1.....	93.0	91.0	87.9	86.7	87.0	*86.0	82.0
2.....	97.3	98.5	94.6	93.7	94.6	94.6	79.0
3.....	96.6	97.3	96.0	93.6	97.0	96.6	79.0
4.....	94.8	95.6	94.4	93.5	96.3	92.1	80.0
5.....	94.5	92.0	92.5	92.3	.....	91.5	81.5
6.....	97.1	95.5	97.1	94.1	93.5	93.3	69.0
7.....	96.0	91.5	91.3	88.0	93.4	85.2	71.0
8.....	92.2	89.6	89.0	80.0	89.2	76.2	81.0
10.....	96.2	91.7	95.0	90.6	92.5	88.5	81.0
11.....	94.0	95.5	94.5	94.5	96.5	93.0	88.0
12.....	96.9	95.5	93.0	92.6	95.5	92.3	91.5
13.....	92.0	92.0	93.0	91.5	92.2	90.5	87.5
14.....	95.0	96.0	94.0	93.0	93.5	91.0	83.0
15.....	95.3	93.0	93.0	89.6	94.4	89.6	87.0
16.....	95.5	90.0	91.2	89.5	88.5	89.0	80.0
Average.....	95.0+	94.3+	93.8+	90.0	93.0+	90.0	81.4

HIGH RENNET.

1.....	95.3	95.3	91.5	93.3	93.6	93.6	86.0
2.....	96.3	89.3	95.0	89.8	93.8	91.6	93.5
3.....	94.0	92.1	93.0	89.3	90.1	91.0	82.0
5.....	96.3	96.0	94.6	92.8	93.3	93.0	96.5
6.....	88.0	81.3	.....	82.6	84.5	84.2	93.0
7.....	96.6	95.5	94.5	96.6	94.8	94.6	95.0
8.....	97.8	97.3	94.8	95.2	97.0	95.3	94.0
9.....	93.2	90.6	89.4	89.0	87.6	87.2	77.0
10.....	91.8	94.3	.....	90.0	92.0	89.3	94.5
11.....	93.8	92.6	94.3	90.3	92.2	91.0	87.5
12.....	96.0	91.5	94.3	91.1	89.0	90.0	97.0
Average.....	94.4+	92.3	93.4	90.3	91.6	90.9	90.5

As shown by the general average in Table VI, the cheese put in the 32-degree room direct from the hoop gave the highest score, though the score was very little higher than that for the cheese placed in the 40-degree room at the same time. Of the lots of cheese placed in the cold rooms at 1 and 2 weeks of age, the 32-degree lot shows an advantage very marked in the low-rennet series and not quite so marked in the high-rennet series.

In the scores for the individual lots a number of cases are found where the cheese held in the 40-degree room is given the higher score. In lot 10 of the high-rennet cheese the cheese placed immediately in the 40-degree room scored on an average 2.5 points higher than the cheese placed in the 32-degree room. In a few other cases there was a difference of 2 points in favor of the 40-degree room. It will be noted that lot 10, to which attention is called, scored very evenly all the way through, getting a very good score on the cheese cured in the factory curing room. This was true in every other case where the cheese held at 40° F. scored as high as that kept at 32° F.

On the other hand, there were some instances of wide variation in scores in favor of the 32-degree temperature. As an example, lot 7, low-rennet cheese, 2 weeks of age at time of scoring, shows a variation of 8 points in favor of the 32-degree room. Lot 8, low-rennet cheese, shows a variation all the way through. In looking at Table III in the descriptive score for these lots, we find that taints developed in the cheese kept out of the cold rooms for one and two weeks which did not show in the cheese placed at once in the cold room. Further, after these taints had once started to develop, it would certainly appear that the 32-degree temperature served much better to hold them in check than the 40-degree temperature. These points are illustrated and emphasized in many instances in the descriptive score. The influence of the colder temperature seemed about equal on flavor and texture.

The greatest beneficial influence of cold curing is with what would otherwise be poor cheese. Because of this fact Tables III and IV are much more interesting and show more valuable information than the table of average results. Cold curing derives its value chiefly from its effect on what might otherwise be poor cheese rather than from any effect it may have in bettering all cheese.

COLD CURING AND ACID CHEESE.

Perhaps the most interesting feature brought out in all this work is shown in the descriptive scores of lots 7 and 8, low rennet, and lot 9, high rennet. These three lots were allowed to develop too much acid in the process of making, and under ordinary conditions of placing in storage at 2 weeks of age lot 8 would have been a "dead sour." The cheese held in the factory two weeks and placed in the 40-degree room was much deteriorated, while the one that went fresh from the press to

the 32-degree room was very good. It was evident that with this lot of cheese the 32-degree temperature checked the acid much better than the 40-degree temperature. It has been generally believed by dealers that a cheese with too much acid should be kept out of storage as long as convenient, as acid has been supposed to develop more and cause greater injury to the cheese by going early into the cold storage. It would appear from the results with the three lots mentioned that the quicker an acid cheese can be placed in cold storage and the colder the room the better the cheese will be. This is a very important subject with the dealers, for this question of acid is the principal obstacle to the buying of cheese by the dealer as it comes from the hoop. Further investigation of this point is needed, and will be undertaken in the near future.

VARIATIONS IN SCORES OF THE DIFFERENT JUDGES.

Some explanation is needed of the wide variation of scores as given by different judges. The separate scores of each of the three judges are indicated by the initials of their names—B. (Baer), S. (Steinhoff), and W. (White).

As before mentioned, Mr. Baer represented the experimental side, while the other two judges were commercial men. Mr. Baer's scores, therefore, naturally presented a much wider variation than those of the other judges. He took off more for faults. A condition which was not anticipated was found in the tendency of Mr. Steinhoff to mark down the cheese that had been held in the factory for two weeks before curing, because, as he said, it had too high a flavor for the English market. This cheese had barely commenced to develop a good cheese flavor, and had not become sharp in the least. The other two judges were inclined to favor it because of the characteristics which Mr. Steinhoff condemned. The view taken by Mr. Steinhoff was something of a surprise, as it was generally understood that the English people were lovers of cheese with a well-developed, even sharp, flavor. Mr. Steinhoff said that the English demand for milder cheese was growing very rapidly. If this continues, it is only a matter of a very few years until all cheese, if ripened at all, will have to go through the ripening process under conditions of temperature that will entirely suppress flavor development.

As has been stated, the demand for mild cheese has grown by leaps and bounds in this country until it has become possible to dispose of cheese to consumers under two weeks from the time it leaves the press. We do not care to enter into any discussion of the desirability of this popular taste. It would certainly appear to most people who eat cheese because they love it that this tendency is wrong and can have no beneficial effect in the increased use of cheese as a regular part of the diet.

There has been some reason to believe that the consumption of green cheese was due to the fact that such a product was forced on the consumer by the dealers and retailers, so a test was determined on. Arrangements were made with one of the retail dealers in the market at Washington, D. C., to sell three kinds of cheese as an experiment. One lot was under 2 weeks of age and to all appearance had not broken down in the least. Another lot had been ripened from the hoop in a 32-degree temperature and was well broken down but almost without flavor. The third lot had been carried in the factory curing room and then held in a 40-degree room for several months. It was the cheese which Mr. Steinhoff criticised as being too strong for the English market, but which was highly praised by the other judges. These three cheeses were exposed for sale in two different markets, samples from all three lots being placed side by side and customers asked to select. In one stall 8 customers selected the green cheese, 24 selected the mild cold-cured cheese, and 11 selected the cheese with the well-developed flavor. At the other stall 30 selected the green, uncured cheese, 29 selected the mild, well-cured cheese, and 11 selected the cheese with the marked flavor. It would appear from this that the mild cheese, either cured or uncured, was preferred by most buyers.

The writer has no comment to make on this except to repeat that from all indications the time is soon coming when all cheese, if ripened at all, must be ripened at low temperatures; and, further, the sooner it is put into cold storage the better.

RELATION OF GREEN CURD TO CURED CHEESE.

Some interest attaches to the question of how much the quality of the ripened cheese depends upon the quality of the curd during the process of making. It has been usually considered that any undesirable quality likely to be found in the ripened cheese will first appear in the curd sometime during the process of making. In other words, a faulty or tainted curd makes a poor cheese; or, vice versa, a good curd makes a good cheese. Many cheese makers in selecting a cheese for exhibition make the selection by the character of the curd. Lots 12, 14, and 16 (low rennet) and lot 9 (high rennet) in Table I were tainted. The descriptive score shows that lot 12 scored unusually high, lot 14 was about as good, while lot 16 was not a bad cheese. Lot 16 was tainted at the time of scoring, but the other two were not, and had evidently not been influenced by the taint which appeared in the curd. Lot 9 of the high-rennet series turned out to be bitter, but the cheese which went direct into the 32-degree room from the hoop was a very fine cheese, evidently above all criticism.

On the other hand, lots 6 and 13 (low rennet) are marked as very fine curds, as are lots 10, 11, and 12 (high rennet). Lot 6 scored very well, but the others did not score as high as might have been expected.

EFFECT OF EXTRA RENNET.

The advisability of using extra quantities of rennet has not yet been determined. It was found that the cheese broke down faster with high rennet, but this fact has been demonstrated before. Theoretically, where the supply and demand make it necessary to use very young cheese, anything that will hasten the ripening process would be desirable. There is reason to doubt whether this would pay in practice. With regard to the comparative keeping qualities of the high and low rennet cheese, it was stated by the Wisconsin Station that in its experiments the high-rennet cheese deteriorated in quality much quicker than that made with normal rennet. This was not found to be true of the cheese made for the experiments of the Dairy Division. In these experiments it was found, on the other hand, that while the high-rennet cheese broke down in a much shorter period of time than the normal rennet cheese, it held its good qualities fully as long if not longer than the low-rennet cheese. From the scores of the factory-cured cheese it might appear that additional rennet aided the cheese in some way to withstand the warm temperature of the factory curing room.

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